GENERAL SCIENCES

Science

Dept. of Agriculture

ALBERTA FARM GUIDE

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As men[illegible] ublished to co-ordinate a[illegible] he use of farmers. It pr[illegible] pics but is not intended [illegible] sive information on any [illegible]

Sources of more detailed information on farming matters are:

District Agriculturists (see page 176)

Extension Service,
Alberta Department of Agriculture,
Edmonton.

Department of Extension,
University of Alberta,
Edmonton.

Information Division,
Canada Department of Agriculture,
Ottawa, Ontario.

FOREWORD

Financed jointly by the Canada and Alberta Departments of Agriculture, the Alberta Farm Guide has met with enthusiastic response.

Since its release in 1959, 30,000 copies have been provided for use of Alberta farmers and others engaged in agriculture. With the previous stock depleted, revision has been made and the sections brought up to date by the subject matter specialists (inside back cover).

As mentioned earlier, the Alberta Farm Guide was published to co-ordinate and consolidate a wealth of information for the use of farmers. It provides a brief reference on a wide range of topics but is not intended to meet the needs of farmers requiring extensive information on any specific phase of agriculture.

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ALBERTA FARM GUIDE

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Prepared by representatives of :

THE UNIVERSITY OF ALBERTA
THE CANADA DEPARTMENT OF AGRICULTURE
and
THE ALBERTA DEPARTMENT OF AGRICULTURE

Distributed by
EXTENSION SERVICE

HON. HARRY E. STROM
Minister

Contents

Climate of Alberta

The climate of Alberta is predominantly continental. A Continental climate has greater extremes and variability than a Maritime climate. Most of the air circulating over the province, comes either over the mountains from the west or from the north and northwest by way of the Mackenzie Basin. Alberta is located too far west to receive, to any significant degree, the warm moist air from the Mississippi Basin, which frequently penetrates northward into Saskatchewan and Manitoba.

The mountains modify the climate. Air from the west may bring a chinook, while the cold air from the north is steered eastward by the mountains so that moderation of the cold air takes place in Alberta before it occurs to the east.

At the same latitude the western parts are warmer in the winter than the eastern parts. While in winter the temperature gradient from south to north is considerable, in the summer it is very slight. Summer temperatures do not limit crop production in the northern areas as much as might be expected.

Extensive precipitation usually is caused by the warm Pacific air crossing the mountains and converging with the drier, cooler air over Alberta. Prolonged precipitation occurs with surface winds from the east, while aloft the Pacific air rising over this lower layer becomes chilled and its moisture falls out as rain or snow. Some of the more extensive rains in the south may occasionally be due to a similar association of warm, moist air from the Mississippi Basin and cold Polar air. Much of the useful summer rainfall comes in the form of heavy showers, occurring when the air is unstable. Air can become critically unstable by heating from below as it passes over hot ground or by cooling aloft.

WINDS

The wind pattern over Alberta is complex. The mountains provide a steering and blocking effect. Winds may vary markedly in speed and direction over short distances. Close to the mountains the winds are mainly westerly, while farther away from the mountains winds from the south to southeast and northwest predominate.

A famous wind in Alberta is the chinook. The expression is properly used for the strong warm winds which blow eastward from the mountains. The chinook blows most often in southwestern Alberta but areas in or adjacent to the foothills are often affected all the way from Calgary through Rocky Mountain House to Edson and the Peace River country. The air involved originates over the Pacific and is mild relative to the prairies during the winter. This mild air gains heat by condensation processes on the mountains and by compression descending the east side of the mountains. Relatively strong winds aloft are required to force the mild air into descent over the prairies, or out of the mountain valleys from B.C. The chinook then bursts forth in favourite locations — typically near a valley such as the Crowsnest Pass of Southwestern Alberta and fans out eastward. A typical Chinook might be considered as ranging from 25 to 50 mph with gusts to over 100 mph. The Chinook weakens rather rapidly in about 100 miles from the mountains, although the mild air may be carried farther east. Chinooks have their greatest frequency during the fall, winter and spring. Chinooks remove snow which increases the grazing season but may increase winter killing of certain plants. Soil drifting is a problem in southwestern Alberta.

Strong, northwest to north winds bring blizzards in winter and some soil drifting in spring.

SOLAR RADIATION

Alberta being well to the north, the sun is relatively low, particularly in winter. In summer, Alberta usually receives adequate solar energy. At this season there is only a slight difference in the amount of solar energy received from south to north, as long days in northern Alberta compensate for the lower elevation of the sun. Alberta loses a great deal of its sun energy in winter, because of the high reflecting and radiating power of the snow.

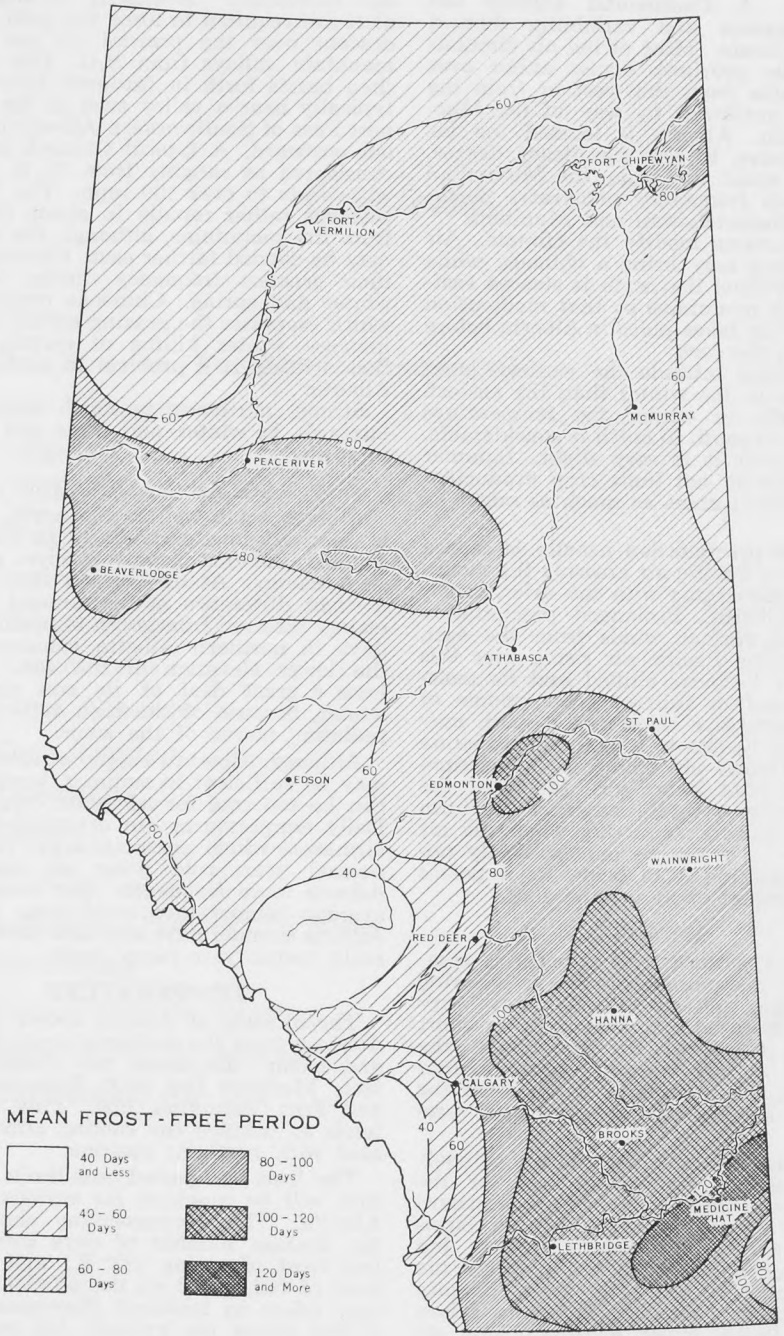
Although Alberta's supply of solar energy may be sufficient in summer, temperatures can be too cool for adequate crop growth. Daily temperatures are determined by the airmasses which enter an area. In an abnormal year, cold polar air may enter Alberta more frequently than usual. With average temperature conditions, the long Alberta summer days stimulate and promote early maturity in many crops.

TEMPERATURE

The altitude of Alberta shows a general decrease from the southwest toward the east and north. Elevations are Calgary, 3400 feet; Medicine Hat, 2400; Edmonton, 2200; and Fort Vermilion, 950. This condition tends to balance the cooling effect associated with northern position.

The frost free period puts limits on crops that will be practical for various parts of Alberta. The accompanying chart shows the average number of days between the last frost of spring (32° F.) and the first frost of fall, based on the official temperature taken in louvered Stevenson screens 4 feet above the ground. On calm clear nights the crop level temperature may be significantly lower than the official temperature.

A temperature of 28° F. or lower is con-


FORT CHIPEWYAN
FORT VERMILION
McMURRAY
PEACE RIVER
BEAVERLODGE
ATHABASCA
ST PAUL
EDSON
EDMONTON
WAINWRIGHT
RED DEER
HANNA
CALGARY
BROOKS
MEDICINE HAT
LETHBRIDGE
60
80
100
40
MEAN FROST-FREE PERIOD
40 Days and Less
40 - 60 Days
60 - 80 Days
80 - 100 Days
100 - 120 Days
120 Days and More

sidered to be a killing frost. The killing-frost-free period then may often be 3 weeks to a month longer than the frost-free period. Some crops are not damaged by light frosts.

The mean frost-free period becomes shorter northward and westward from Medicine Hat. The Peace River country enjoys a longer frost-free period than the surrounding areas. A more detailed chart would show local variations since the frost-free period is so dependent on topography. Low spots situated in the foothills or in northern areas may have frost in any month. The Meteorological Branch issues warnings of spring and fall frosts in its public forecasts.

Monthly mean temperatures are above 50° F. for the five months May to September in most parts. Temperatures rise rapidly in April and fall rapidly again in October. The peak heat of summer is near the end of July, with typical highs of 85 in the south and 75 in the north.

PRECIPITATION

Alberta is in the rain shadow of the Rocky Mountains and is therefore relatively dry. However the map on Page 6 shows that there are marked variations in the average annual precipitation over the province. Precipitation is greatest along the foothills, diminishing rather rapidly toward the east and toward the north. There is a band of fairly heavy precipitation in a southwest to northeast line from south of the Peace River Region across the Swan Hills to the Pelican Mountains and eastward. This heavy precipitation is associated with higher ground, most of which is heavily forested.

Water loss by evaporation from the soil plus that consumed or transpired by crops is termed "evapotranspiration". This varies from one region to another. High rates are caused by wind, sunshine and high temperatures. The value of snowfall in the production of crops varies throughout the province from year to year. In general, snowfall constitutes only about 25% of the total annual precipitation. Chinooks melt the snow and the moisture is evaporated in southern Alberta. Heavy run-off wastes much of the snow moisture in the Peace River and other northern regions.

CLIMATE VARIATION

Agriculture in Alberta is carried on very close to minimum climatic conditions. While average weather conditions are favourable, extreme deviations are so frequent that the production of some crops becomes a risky undertaking.

Rainfall variability is greatest in the prairie region, somewhat less in the parklands and least in forested areas.

Late spring and early fall frosts increase the risks of agriculture in the northern and western areas. Fortunately the drought hazard is less in these areas. Spring frosts do not limit agriculture to the extent that early fall frosts do. When ripening is delayed, fall frosts can be disastrous. Early seeding, and the use of phosphatic fertilizers hasten maturity, reducing the risk of frost damage.

WINTER KILLING

The range of crops grown in Alberta is restricted because of the climate in winter. Lack of protective cover (e.g. snow) and resultant temperature changes in the root zone, cause winter killing. Other factors are: sharp drop in temperature resulting in freezing within plant cells; killing frosts before the plant has matured or changed to winter dormancy; and the breaking of dormancy during the winter. Very little data are available on frost penetration in Alberta and its effect on the winter survival of crop. However, the depth of frost penetration is not thought to be an important factor in winter killing. Snow cover is more persistent in the parkland, and wooded areas than in southern Alberta.

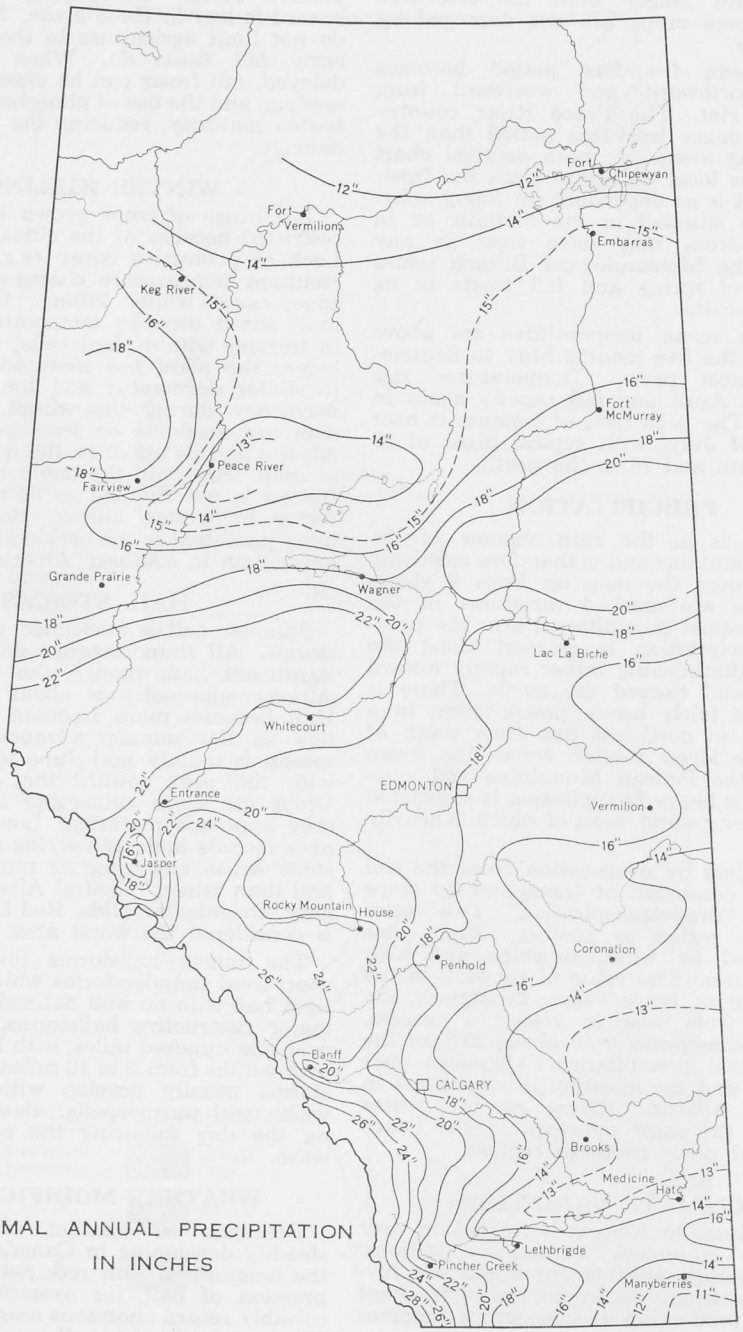
HAIL STORMS

Summer hail is associated with thunderstorms. All thunderstorms do not produce significant hail, though the frequency in Alberta apparently is about one in five. Hail becomes more frequent and destructive as the summer advances. The hail season is mainly mid June to late August with the peak toward the end of July. Crops are more vulnerable to damage as they approach maturity. Long-term insurance records indicate varying patterns, with some areas emerging as more subject to hail than others. Central Alberta (e.g. Calgary, Drumheller, Olds, Red Deer, Ponoka) is considered the worst area.

The minor hailstorms involve isolated short-lived thunderstorms which give spotty light hail with no well defined pattern. The major destructive hailstorms, often travel over one hundred miles, with heavy damage over widths from 5 to 10 miles. These major storms usually develop with cold fronts which end warm spells. Some may occur on the day following the end of a heat wave.

WEATHER MODIFICATION

Research on weather modification is steadily developing in Canada. Changes in the amounts of rain received and the suppression of hail, for example, could conceivably return enormous economic benefits. However, scientists all over the world, recognize that rainfall cannot be turned on or off at will; but it is generally agreed that rainfall may be increased by something



NORMAL ANNUAL PRECIPITATION
IN INCHES

like 10 or 15 per cent by treating clouds chemically when conditions are favorable.

In rain stimulation, seeding promotes the appearance of ice crystals, which, after growing as snowflakes melt and fall as rain. Summer rains may develop occasionally without ice crystals, in which case seeding with other materials might induce rain. The principle of hail suppression, as practised at present, involves the "Freezing-Out" of cloud masses, preventing the growth of hail to damaging size.

The evaluation of rainmaking and hail suppression in Alberta cannot be made yet, because of insufficient statistical data. Rainfall is quite variable, but the incidence of hail is even more variable. The Meteorological Branch is conducting a rainmaking experiment in Quebec, while a joint group—'Alberta Hail Studies'—is studying hail in central Alberta. Two problems face hail research: first, identification of the processes of hail formation, so that the true effects of seeding can be predicted; second, assessment of a hail suppression program. Similar problems face research in rainmaking.

LONG RANGE FORECASTING

Reliable long range forecasts of weather are still not possible. The United States Weather Bureau issues 5-day and 30-day forecasts of precipitation and temperatures compared to normal. The Canadian Meteorological Branch plans to extend into this field gradually. Private meteorologists also have issued long range forecasts. Forecasts for a month are of some use to agriculturists, although at present three-day forecasts similar to those issued during the growing seasons of 1961 and 1962 are more likely to be of help to Alberta farmers. This was an experiment conducted jointly by the Meteorological Branch (Department of Transport), and the Provincial Department of Agriculture.

Examination of climatic data for Alberta gives little encouragement to attempt forecasts for several months (e.g. an outlook for summer issued in the spring). There is some tendency for persistence in weather patterns, but the prediction of the beginning or end of such spells is still most difficult. Some breakthrough in meteorological knowledge, combined with machine methods is the only hope at present for seasonal forecasts.

CLIMATIC TRENDS

The most reliable information on the departure of the ice age from our prairies sets the time at 9,000 years ago. The ice melted, according to one theory, because of a trend toward warmer weather over a period of several thousand years. Geologists have estimated a rise in mean annual temperature of 10° F. since the last ice age, or about one degree each 1,000 years. For the agriculturist, whose brief span is reckoned in years, these trends are of little importance. We would be foolish to believe that a series of wet years indicate a trend or that a series of violent storms is a result of atomic explosions.

The drought in the 1930's, the long series of fairly wet years thereafter, and the dry spell of 1960-61 broken in 1962, are only examples of the variability in weather patterns. No one can predict weather for years ahead since detailed studies fail to reveal reliable cycles.

REFERENCES :

Queen's Printer of Canada:
The Climate of Canada (25c).

Climate of Central Canada ($1.00).

Meteorological Office, Toronto:
Vol's I, II, III — Climatic Summaries of Selected Stations.

Atlas of Canada, Dept. of Mines, Ottawa $25.00).
(selected maps, 50c each).

Soil Zones and Fertilizer Recommendations

SOIL ZONES

The soils of Alberta have been divided broadly into six major soil zones as shown on the Soil Zone Map. These have been described in a number of published papers and soil survey reports. From the relatively dry Brown soil zone of south eastern Alberta the moisture efficiency increases and the climate becomes progressively more humid towards the west and north, and this has had a profound effect on the native vegetation and the character of the soils.

The semi-arid Brown prairie soil zone of south-eastern Alberta covers about 12 million acres. The surface soil horizon is generally light brown to brown in color. This is a short grass prairie region, and only the heavier or drought resistant soil types in this zone can be considered arable, except in districts where the soil is irrigated. Most of the area is desirable for ranching. This soil zone is not favourable to the growth of legume crops such as clovers and alfalfa, except under irrigation. Moisture is the major limiting factor in crop production and fertilizers are not generally recommended for dry land farming.

North and west of the Brown soil zone lies the Dark Brown and then the Thin

Black soil zone, approximately equal in size and together covering about 15 million acres. The surface horizon of the former is generally dark brown in color and the upper 3 to 6 inches of the latter are generally black or very dark brown. These are grasslands partially invaded by trees, mainly deciduous. Wheat is the principal crop grown but considerable diversification is possible. Legumes such as sweet clover and alfalfa can be grown successfully on these soils, and in addition to grasses, should be more widely grown to maintain the soil nitrogen and organic matter content. These two zones are considered together from the standpoint of fertilizer recommendations in this publication.

The Black, Dark Grey and Dark Grey Wooded soil zones of central Alberta and the Peace River region cover about 10 million acres. They consist of grasslands partially invaded by trees, mainly poplar. In this publication these zones are considered together from the standpoint of fertilizer recommendations. The Black soils have a black to very dark brown surface layer that averages about 12 inches in depth. The Dark Grey soils, characteristic of transition areas between grassland and forest vegetation, are slightly lighter in colour than the Black soils. Dark Grey Wooded soils, found in forested areas, have a grey leached layer near the surface, but are nevertheless relatively fertile. These soils are comparatively rich in total organic matter and nitrogen, but they often respond to applications of available nitrogen and phosphorus. Legumes and grasses can be grown successfully on these soils and should be included in rotations with cereal crops.

The Grey Wooded soil zone lies west and north of the central Black soil zone and covers about two-thirds of the entire province, but it is doubtful if more than about 14 million acres are arable. The native vegetation consists of a mixed deciduous and evergreen woodland in which peats frequently occur. The undisturbed soil profile is usually characterized by a thin surface layer of semi-decomposed leaf litter above a severely leached and bleached greyish layer averaging 6 to 8 inches thick, and a heavier textured underlying horizon. The soils in this zone are very deficient in organic matter and nitrogen, often deficient in phosphorus, and in many areas, deficient in sulphur. It is essential to grow legumes such as clovers and alfalfa, or mixtures of legumes and grasses, in order to add nitrogen and organic matter to the soils.

FERTILIZERS AND PLANT NUTRIENTS

Plant nutrients are chemical elements which crops must obtain from the soil and atmosphere in adequate amounts if they are to grow satisfactorily. A fertilizer supplies one or more plant nutrients, of which nitrogen, phosphorus, potassium and sulphur are examples. Farm manure, green manures, legumes and commercial fertilizers all are used to supply one or more of these elements in order to improve crop yields.

Of the essential chemical elements which plants must obtain from the soil there are four that are most likely to be deficient in Alberta soils. These are nitrogen, phosphorus, potassium and sulphur. Each has specific essential roles in plant nutrition.

What nitrogen does:

—Gives dark green color to plants.
—Produces rapid growth.
—Feeds soil micro-organisms during their decomposition of low-nitrogen organic materials.
—May increase yields of leaf, fruit, or seed.
—May improve quality of leaf crops.
—May increase protein content of forage crops and grains.

What phosphorus does:

—Stimulates early root formation and growth.
—Gives rapid and vigorous start to plants.
—Gives winter hardiness to fall-seeded grains and hay crops.
—Often hastens maturity.
—May stimulate blooming and aid in seed formation.

What potassium does:

—Imparts increased vigor and disease resistance to plants.
—Produces strong, stiff stalks, and thus may reduce lodging.
—Essential to the formation and transfer of starches, sugars, and oils.
—Imparts winter hardiness to legumes and other crops.

What sulphur does:

—Gives increased root growth.
—Helps maintain dark green color.
—Promotes nodule formation on legumes.
—May stimulate seed production.
—Often increases protein content of alfalfa and clovers by 1/10 to 1/4.

Calcium and magnesium and the seven so-called trace elements all have their own specific roles in plant nutrition. However, tests to date have not yet found a general deficiency of any of these elements anywhere in Alberta.

Alberta soils in general appear to contain sufficient potassium. Responses to potassium have occurred only in isolated cases, mainly in peat fields.

NOTE—Some common names are widely used when referring to compounds containing the chemical elements supplied by fertilizers. Examples follow.

Chemical element	Some common names applied to compounds containing element
Nitrogen	ammonium; ammonia; urea; nitrate
Phosphorus	phosphate; phosphoric acid; phosphorus pentoxide
Potassium	potash
Sulphur	sulphate

FARM MANURE

Farm manure is one of the best fertilizers. It supplies not only plant nutrients, but it adds organic matter to the soil. This organic matter improves the physical condition of the land and helps it to hold moisture and resist erosion. Manure is rather low in phosphate, so phosphate fertilizers generally should be added.

On most Alberta farms there is not enough manure to supply all the fertilizer needed, but even a limited supply can be used to advantage. Spread over as large an area as practical, manure will give greater immediate returns per ton than if spread heavily. Usually it is better to utilize 30 tons on three acres than on one acre. The effect of a good application of manure will last for several years.

GREEN MANURE

Green manuring is another way to improve the soil. Immature cereal or legume crops worked into the land add organic matter, improve the physical condition of the soil and often increase the supply of available plant nutrients.

Green manures do not add any mineral that they have not previously taken from the soil but the supply of nitrogen may be increased by plowing under properly inoculated legumes. Inoculation introduces bacteria which, in association with the legume roots, change nitrogen of the air into compounds useful to both the bacteria and the legume. Cereal crops that follow also benefit from this increase of nitrogen in the soil.

Green manuring in Alberta should be limited to the following cases.

(1) On irrigated land, preferably using a legume.

(2) On Grey Wooded soils using a legume or a legume-grass mixture.

(3) On grain farms, where sweet clover is seeded with grain to produce a beneficial legume crop as a substitute for fallow after grain.

(4) In other areas of Alberta green manuring should generally be limited to legume and grass stands being broken up from hay or pasture.

On irrigated land and Grey Wooded soils the best results are sometimes obtained by plowing down the entire crop, but beneficial results are also generally obtained when the hay crop is removed before plowing. When the legume is plowed immediately after haying, the addition of nitrogen to the soil is not as great. The amount added is more or less proportional to the amount of legume plant material returned to the soil. It is probably better to cut the hay early, and, if moisture conditions are favorable, let the legume make some regrowth before plowing down.

Under dry-land conditions in the Black soil areas the most efficient method is to remove the hay early, about the end of June, and plow down the stubble immediately.

A high analysis phosphorus fertilizer usually gives excellent returns on land that has been green manured with a legume.

COMMERCIAL FERTILIZERS

Commercial fertilizers are manufactured products that contain one or more plant nutrient elements. They supply in concentrated form the same nutrients that plants obtain from the soil. Used in accordance with recommendations in this Guide commercial fertilizers cannot injure the soil or crops in any way. A guaranteed analysis of the nitrogen, phosphorus and potassium content must be clearly indicated on the fertilizer bag or container. This ruling, provided under the Canadian Fertilizer Act, is for your protection and guidance.

WHAT'S IN THE BAG?

When buying a commercial fertilizer study the figures on the container and be guided by them. They may save you money. They show the percentage of nitrogen, phosphate and potash—and always in that order. For example, a fertilizer labelled 10-30-10, contains 10% nitrogen (N), 30% phosphate (P_2O_5) and 10% potash (K_2O). These figures show the major plant nutrients you are getting and with their help you can choose the fertilizer that will supply most economically the plant nutrient or nutrients required. Most fertilizers also contain small quantities of other plant nutrient elements that may be beneficial to plant growth, but these are not usually shown on the container. Sulphur is such an element, and some of our soils in Alberta need this plant nutrient.

From the cost of fertilizers, the cost per pound for each of the various nutrients may be calculated as follows:

For nitrogen (N). One ton of ammonium nitrate contains 670 lbs. of nitrogen (33.5% shown in Table 1). If one ton of ammonium nitrate (670 lbs. of nitrogen) costs $81.00, then one pound of nitrogen costs approximately 12 cents.

Similarly with phosphate and potash — using the analysis shown on the bag it is

simple to calculate the number of pounds of each element in a ton of the fertilizer. It is then equally simple to determine the price per pound of the element concerned.

In Table 1, below, you will find the guaranteed analysis and the sulphur content of some of the fertilizers sold in Alberta.

TABLE 1

Information on Some Fertilizers Available in Alberta, 1962

Name of Fertilizer	Guaranteed Analysis N% (Nitrogen)	P_2O_5% (Phosphate)	K_2O% (Potash)	Sulphur content %
Anhydrous ammonia	82	0	0	0
Ammonium nitrate	33.5	0	0	0
Ammonium sulphate	21	0	0	25
Urea	45	0	0	0
Ammonium nitrate-phosphate	27	14	0	low
Ammonium nitrate-phosphate	24	20	0	low
Ammonium nitrate-phosphate	23	23	0	low
Ammonium phosphate-sulphate	16	20	0	14
Ammonium phosphate	11	48	0	low
Complete	10	30	10	5
Farm manure	0.5*	0.25*	0.5*	low
Potassium chloride (muriate of potash)	0	0	60	low
Potassium sulphate (sulphate of potash)	0	0	51	20
Gypsum (calcium sulphate)	—	—	—	18
Sodium sulphate (dry)	—	—	—	22
Sulphur (commercial)	—	—	—	98

* Plant nutrients in manure vary with the kind and age of the manure.

ANHYDROUS AMMONIA

This high analysis fertilizer (82-0-0) is a suitable source of nitrogen but special equipment is required since it is marketed as a liquid stored under pressure in special tanks. The liquid vaporizes on release of pressure and the ammonia gas produced must be applied by means of a special type of applicator, such as a chisel, which places it below the surface. Anhydrous ammonia application requires a separate operation sometimes, but this may be combined with soil tillage. The gas itself can be dangerous. Therefore it is essential that those working with ammonia know how to use and handle it safely. Operators should wear tight fitting goggles and rubber gloves when making adjustments to any parts of the equipment that are under pressure. Tests to date in Alberta and elsewhere indicate that pound for pound, the effect of nitrogen is the same whether it be in the form of 82-0-0, 33.5-0-0, or 21-0-0.

LIQUID FERTILIZERS AND FORTIFIED DUSTS

Tests to date indicate that liquid fertilizers available in Alberta as seed treatments are not effective or economical forms of fertilizers for grains. Liquid fertilizers applied with 2,4-D have not proved profitable for Alberta crops.

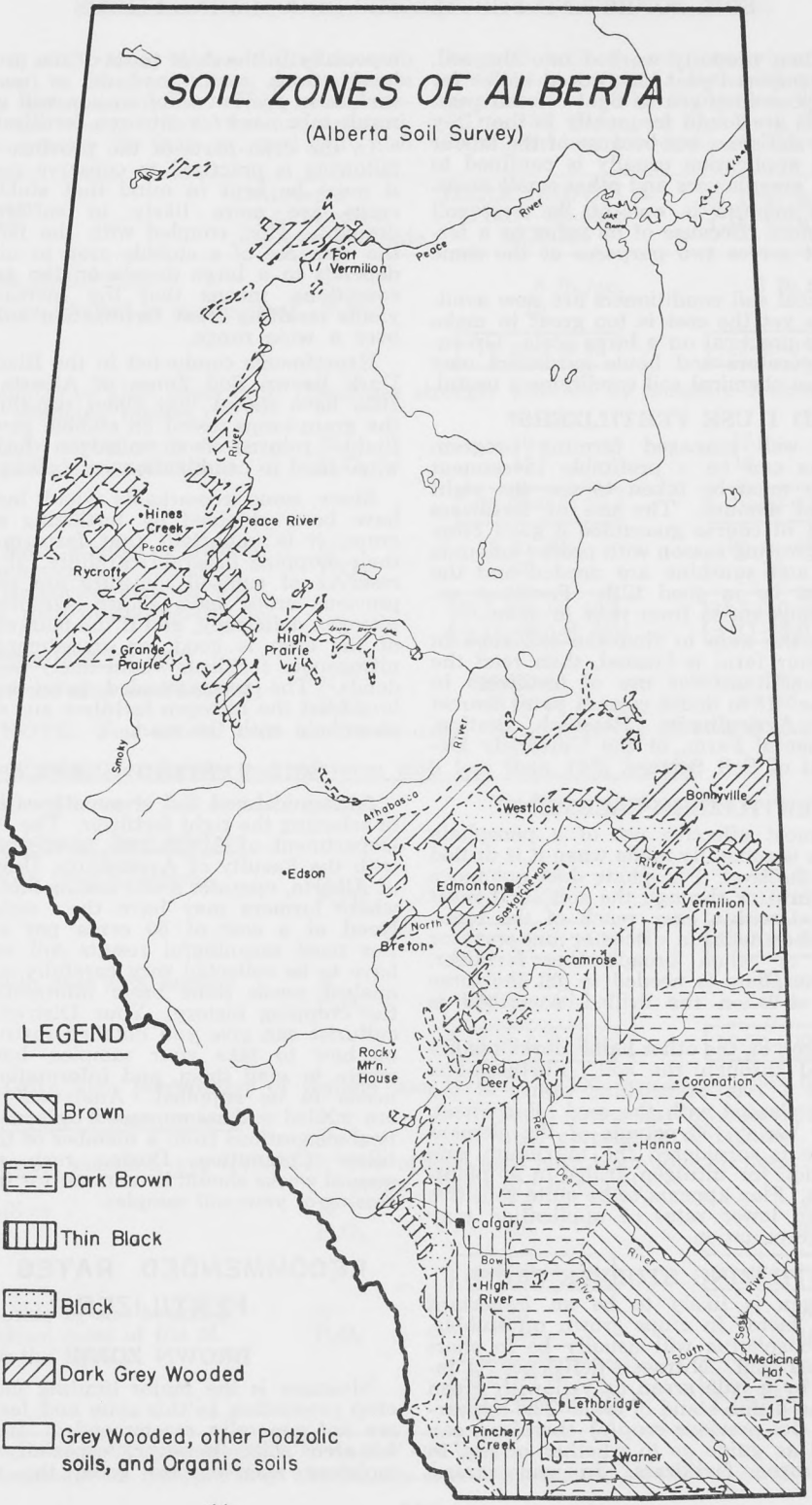
Foliar application of fortified dusts, leaf-feeding dust fertilizers or liquid fertilizers are not recommended at present, but experimental work with them is being continued.

SOIL AMENDMENTS

Soil amendments provide another type of soil improver. They may or may not act as fertilizers. Lime and peat are examples of these materials.

Lime may be used as a soil amendment to correct an acid condition of the soil. As a fertilizer it may serve to supply calcium. **Very few Alberta soils need lime.** If you suspect that your soil is acid, send a sample to the Agricultural Soil and Feed Testing Laboratory, University of Alberta, Edmonton, Alberta. A simple test will show whether or not lime is likely to be needed. A few soils in the Peace River area have responded to applications of lime but elsewhere in the province soils appear to be well supplied with lime.

Peat may be used to improve the physical condition and moisture-holding capacity of grey soils and clay soils, and to improve moisture-holding capacity of other soils


SOIL ZONES OF ALBERTA
(Alberta Soil Survey)
Fort Vermilion
Peace River
Hines Creek
Peace River
Rycroft
Grande Prairie
High Prairie
Smoky River
Athabasca River
Westlock
Bonnyville
Edson
Edmonton
Saskatchewan River
Vermilion
North Breton
Camrose
Rocky Mtn. House
Red Deer
Coronation
Hanna
Red Deer River
Calgary
Bow River
High River
South Saskatchewan River
Medicine Hat
Lethbridge
Pincher Creek
Warner
LEGEND
Brown
Dark Brown
Thin Black
Black
Dark Grey Wooded
Grey Wooded, other Podzolic soils, and Organic soils

also. When properly worked into the soil, well decomposed peat has proved better for this purpose than coarse light-colored peat. Peatlands are found frequently in the Grey Wooded soil zone, but because of the labour involved application usually is confined to gardens, greenhouses and other small areas.

Farm manure is one of the best soil conditioners. Because of its value as a fertilizer, it serves two purposes at the same time.

Chemical soil conditioners are now available. As yet the cost is too great to make their use practical on a large scale. Greenhouse operators and home gardeners may find these chemical soil conditioners useful.

SHOULD I USE FERTILIZERS?

In a well-managed farming program fertilizers can be a profitable investment but care must be taken to use the right kind and amount. The use of fertilizers does not of course guarantee a good crop. A good growing season with proper amounts of rain and sunshine are needed and the soil must be in good tilth. Fertilizer response thus varies from year to year.

Check the map to find the soil zone in which your farm is located, then read the recommendations for use of fertilizers in that zone. If in doubt consult your nearest District Agriculturist, Research Station, Experimental Farm, or the University Department of Soil Science.

FERTILIZER PLACEMENT

The most effective use of a phosphate fertilizer is generally made when it is drilled in with the seed. Phosphate does not move readily into or through the soil so it must be placed within easy reach of the roots. Thus, when using a discer or one-way for seeding or when broadcasting fertilizer, extra phosphate is needed to get the same results as when the drilled-in method is used.

Nitrogen on the other hand moves readily into and through the soil. Furthermore, there is a risk of seedling injury if too much is planted with the seed. For wheat, oats, or barley, 30 pounds of the element per acre is considered the maximum safe application for nitrogen drilled-in at planting time. Flax appears to be quite sensitive and even lower rates of application may injure germination.

FERTILIZING STUBBLE CROPS

Nitrogen is likely to be an important limiting factor in crops grown on stubble, while phosphorus will usually be in short supply as well. Nitrogen deficiency is indicated by a pale green or yellowish green color and a thin stand of crop. The appearance of the previous crop(s) therefore, can be used as guide as to whether or not to use nitrogen fertilizers. In some areas, especially in the drier parts of the province, heavy trash maintained on or near the surface to prevent wind erosion will usually result in a need for nitrogen fertilization.

In the drier-parts of the province where fallowing is practised to conserve moisture it must be kept in mind that stubbled-in crops are more likely to suffer from drought. This, coupled with the fact that the response of a stubble crop to nitrogen depends to a large degree on the growing conditions, means that the increases in yields resulting from fertilization will vary over a wide range.

Experiments conducted in the Black and Dark Brown Soil Zones of Alberta since 1956 have shown that about two-thirds of the grain crops tested on stubble gave profitable returns from nitrogen fertilizers when used in combination with phosphorus.

Since some remarkable yield increases have been obtained by fertilizing stubble crops, it is important that farmers study their cropping program carefully. If spring reserves of sub-soil moisture are good, if previous crops have shown symptoms of nitrogen deficiency, and if the market value of the crop is good, an investment in a nitrogenous fertilizer would likely pay dividends. The recommended practice is to broadcast the nitrogen fertilizer and drill-in phosphate with the seed.

SOIL TESTING SERVICE

A chemical soil test is sometimes helpful in selecting the right fertilizer. The Alberta Department of Agriculture in co-operation with the Faculty of Agriculture, University of Alberta, operates a soil testing laboratory where farmers may have their soils analyzed at a cost of 50 cents per sample. For most meaningful results soil samples have to be collected very carefully and the analyst needs some basic information on the cropping history. Your District Agriculturist can give you detailed instructions on how to take your samples, how and where to mail them, and information that needs to be supplied. Analytical results are mailed out accompanied by some practical suggestions from a member of the Fertilizer Committee. During rush seasons several weeks should be allowed for the processing of your soil samples.

RECOMMENDED RATES OF FERTILIZER

BROWN ZONE

Moisture is the major limiting factor in crop production in this zone and fertilizers are not generally recommended. In heavy textured soils, however, especially when moisture reserves are good, the use of

11-48-0 at 30 to 40 lb./ac. drilled in with the seed is likely to prove profitable on grains grown on fallow. This would probably also apply to flax, rape and mustard. Tame grasses for hay or seed will also respond well to nitrogen when moisture conditions are good. For seed production, broadcast in early September 33.5-0-0 at 75 to 150 lb./ac. or 21-0-0 at 120 to 240 lb./ac.;for hay broadcast in fall or spring.

CROPS	Nutrients N = nitrogen P_2O_5 = phosphate	DARK BROWN & THIN BLACK ZONES	BLACK & DARK GR. WOODED*
Wheat, oats, barley			
On fallow (drilled in application)	N	5 lb./ac.	5 lb./ac.
	P_2O_5	20	25
		11-48-0 @ 40 [1]	11-48-0 @ 50 [1]
On stubble or after cover crop (Response strongly affected by moisture reserves and cropping history.)			
(a) Light stuble or trash (drilled in application)	N	10	15
	P_2O_5	15	15
		16-20-0 @ 75 [1]	16-20-0 @ 85 [1]
(b) Heavy stubble or trash or following sod breaking. (Broadcast most of the N, drill in the P_2O_5.)	N	25 to 40	30 to 45
	P_2O_5	20	25
		33.5-0-0 @ 100 +11-48-0 @ 40 [1]	33.5-0-0 @ 100 +11-48-0 @ 50 [1]
Grasses grown for seed			
(Broadcast after seed harvest)	N	25 to 80	40 to 100
	P_2O_5	0 to 35	10 to 45
(NOTE: Few official tests have been done. Suggest trying 27-14-0 @ 200 lb.)			
Grasses grown for forage and mixtures with less than 10% legume			
(Broadcast in early fall or early spring)		Same rates as above.	
Grass - legume hay mixture			
(a) With 10-25% legume	N	20 to 45	25 to 50
	P_2O_5	10 to 30	15 to 40
		27-14-0 @ 150 [1]	16-20-0 @ 200 [1]
(b) With over 25% legume	N	10 to 25	20 to 40
	P_2O_5	30 to 50	40 to 60
		16-20-0 @ 150 [1]	16-20-0 @ 200 [1]
(with high percentages of legume use 11-48-0 @ 100 instead of 16-20-0.)			
Legumes for forage or seed	N	Same as for hay mixture with	
	P_2O_5	high percentage of legume.	
Flax, rape, mustard, rye (NOTE: Few official tests have been done on these crops. Rates are in doubt.)			
On fallow	N	5	5
	P_2O_5	15	20
		11-48-0 @ 30 [1]	11-48-0 @ 40 [1]
On stubble or sod breaking (Broadcast most of the N, drill in the P_2O_5.)	N	35	45
	P_2O_5	15	20
		33.5-0-0 @ 100 +11-48-0 @ 30 [1]	33.5-0-0 @ 120 +11-48-0 @ 40 [1]

[1] Easiest way to apply recommended levels of N and P_2O_5.

* Recommended for the Dark Grey Wooded soils of the Ft. Vermilion area are given on page 15.

CROPS	Nutrients N = nitrogen P_2O_5 = phosphate	GREY WOODED SOIL ZONE Area west and north of main Black zone.	Region. Peace River
		(In this area sulphur frequently lacking, especially for legumes. Formulations suggested are for sulphur-deficient soils.)	(Rotations are important but sulphur not required in this region.)
Wheat, oats, barley			
On fallow (drilled in application)	N	10 lb./ac.	5 lb./ac.
	P_2O_5	10 to 15	20
	S	0 - 10	0
		16-20-0 @ 70 [1]	11-48-0 @ 40 [1]
On stubble or after cover crop (Response strongly affected by moisture reserves and cropping history).			
(a) Light stubble or trash	N	10	10
	P_2O_5	15	15
	S	0 - 10	0
		16-20-0 @ 70 [1]	16-20-0 @ 70 [1]
(b) Heavy stubble (Broadcast N and drill in P_2O_5	N	25 - 35	30
	P_2O_5	20	15
	S	0 - 15	0
		21-0-0 @ 100 +11-48-0 @ 40 [1]	33.5-0-0 @ 75 +11-48-0 @ 40 [1]
Flax, fall rye, rape (Tentative recommendations)			
On fallow and light stubble	N	10	5
	P_2O_5	15	15
	S	0 - 10	0
		16-20-0 @ 60 [1]	11-48-0 @ 30 [1]
On heavy stubble or sod breaking	N	15	20
	P_2O_5	15	15
	S	0 - 10	0
		16-20-0 @ 80 [1]	33.5-0-0 @ 60 +11-48-0 @ 30 [1]
Grasses for seed			
(Broadcast after seed harvest. For cr. red fescue in P.R. area apply in October)	N	20 to 40	30 to 50
	P_2O_5	0 to 15	0 to 15
	S	0 to 20	0
		(No tests. Try 21-0-0 or 27-14-0)	33.5-0-0 @ 150 [1]
Grasses for forage (Fall or early spring application)			
(and mixture with less than 10% legume)	N	20 to 40	30 to 50
	P_2O_5	0 to 20	0 to 20
	S	0 to 15	0
		33.5-0-0 @ 75 +16-20-0 @ 100 [1]	27-14-0 @ 140 [1]
Grass-legume mixtures			
(If over 25% legume reduce N to minimum)	N	30	40
	P_2O_5	10 to 40	40
	S	25	0
		16-20-0 @ 200 (21-0-0 may be better in some cases) [1]	23-23-0 @ 175 or 24-20-0 @ 175 [1]
Legumes for seed			
Broadcast when planted or on established stand	N	10	15
	P_2O_5	15	20
	S	0 - 10	0
		16-20-0 @ 70 [1]	16-20-0 @ 100 [1]

[1] Easiest way to apply recommended levels of N, P_2O_5 and S.

SOIL ZONES AND FERTILIZERS RECOMMENDATIONS

DARK GREY WOODED SOILS OF FORT VERMILION AREA

Tests conducted to date, although limited in number suggest the following:

Wheat, oats, barley and flax

Fallow	N P_2O_5	5 lb./ac. 20 "	11-48-0 @ 40 [1]
Light to medium stubble and trash	N P_2O_5	10 " 15 "	16-20-0 @ 75 [1]
On heavy stubble and following grass sod breaking	N P_2O_5	30 " 15 "	27-14-0 @ 100 [1]

For flax broadcast 33.5-0-0 @ 75 and drill in 11-48-0 @ 30.

Hay and Pasture—Try 16-20-0 @ 100—300 pounds per acre.

Grasses for Seed—Try 33.5-0-0 @ 100 or 21-0-0 @ 150 put on after seed harvest.

RECOMMENDED RATES OF FERTILIZER APPLICATION FOR IRRIGATED CROPS IN ALBERTA

Nutrient	Sugar Beets	Canning Corn	Peas & Beans	Potatoes	Grains
N=nitrogen P_2O_5=phosphate	(——— Drilled in near or with the seed ———)				
N	10*	10**	5	15	40
P_2O_5	40	40	25	60	20
	11-48-0 @ 80 [1]		11-48-0 @ 50 [1]	11-48-0 @ 150 [1]	

	Alfalfa hay		Grass-legume pasture	
		(Early spring top-dressing)		
N		10		50***
P_2O_5		50		50
		11-48-0 @ 100 [1]		22-23-0 @ 200 [1]

* Add to this a side-dressing of 50 to 70 pounds of N where needed.

** Add to this a side-dressing of 40 to 60 pounds of N where needed.

*** Follow up with a top-dressing in mid-June of 50 pounds of N. To maintain peak production during the late summer a further application of N in mid-July might be considered.

[1] Recommended fertilizer and rate to supply nutrients in amounts suggested.

FERTILIZING SPECIAL CROPS

POTATOES (non irrigated)

Tests so far suggest that the use of 11-48-0 at 100 to 200 lb./ac. The fertilizer below should be placed in bands an inch or two and to the side of the seed pieces.

GARDENS AND LAWNS

Any of the fertilizers containing nitrogen and phosphorus can and should be used on gardens and laws. For complete information write to Department of Extension, University of Alberta, Edmonton. Ask for Circular No. 30, "Soils and Fertilizers for Alberta Gardens and Lawns."

REFERENCES

University of Alberta, Edmonton
Colored Soil Zones Map.
Bul. 21—Grey Wooded Soils and Their Management.
Cir. 30—Soils and Fertilizers for Alberta Gardens and Lawns.

Dept. of Agriculture, Edmonton
Pub. 5—Fertilizers in Alberta.
Pub. 70—Fertilizer Recommendations for Alberta.

Dept. of Agriculture, Ottawa
Pub. 985—Soil Management Practices in the Upper Peace River Region.

Soil Management

Good soil tilth and fertility are of prime importance in erosion control. The objective should be not only to maintain soil fertility and tilth but to improve the soil by proper use of fertilizers, crop rotations and judicious use of tillage implements.

SOIL DRIFTING

The threat of soil drifting is not limited to periods of below-normal precipitation, although continued drought intensifies the hazard. High velocity winds, sweeping across a pulverized soil surface, dislodge fine particles. These, in turn, dislodge and abrade other particles, and drifting becomes cumulative. Very fine particles, high in fertility, are transported considerable distances. Larger particles, low in fertility, are deposited along fence rows and in ditches. Soil drifting seriously reduces the fertility of the soil.

Any practice or agency that will reduce surface wind velocity will reduce or prevent soil drifting.

Three factors that influence the extent of erosion are: surface cover, clod structure, and roughness of the surface. A cover of plant residues or growing crop prevents erosion by reducing wind velocity at the soil surface. Granules or clods too large to be moved by wind protect the finer particles. Cloddy structure is a useful protective measure. Weathering agencies, such as the impact of rain and the repeated process of wetting and drying, break down surface clods and may predispose the soil to erosion. Sandy soils and clay soils particularly are subject to weathering. A rough or ridged surface also helps reduce wind velocity and traps moving soil particles.

Soil drifting can occur at any time when high winds sweep across a fine, loose surface devoid of protection. It is a major hazard on the brown and dark brown soils of Alberta in the spring and fall months. An additional hazard arises in the "Chinook Belt" of southern Alberta during the winter when warm westerly winds remove the snow. The Black and Grey Wooded soils are subject to drifting mostly during the spring.

CONTROL PRACTICES

Trash Cover Farming — Trash cover farming, properly carried out, provides a most effective long-range control practice for use on grain farms. It is defined as a system of managing cereal stubbles and other plant residues to protect the soil from erosion. Excellent protection is obtained if from 1,500 to 2,000 pounds of trash per acre are maintained on the surface of a fallow field and if a major portion of this cover is carried on a seeded field. Spring wheat produces about 100 pounds of straw and stubble with each bushel of grain in the Dark Brown soil zone, slightly less in the Brown soil zone, and somewhat more in the Black and Grey Wooded soil zones.

The practice of trash cover farming is readily applied on Brown and Dark Brown soils and can be used successfully on the Black and Grey Wooded soils. However, on these soils intensive tillage is often required for weed control and this makes trash conservation difficult.

Successful trash cover farming is dependent on the wise choice and use of tillage and seeding equipment.

Generally, the various tillage machines reduce the surface trash cover by the following amounts each time the machine is used:

Wide-blade cultivator	5% to 10%
Rod weeder	0% to 10%
Heavy-duty cultivator	15% to 25%
One-way disc and discer	40% to 60%

High-speed operation at shallow depth with the heavy-duty cultivator can bury up to 50 per cent of the surface trash. Deep tillage with disc machines can bury more trash than indicated above. However, disc machines can be operated 1 to 2 inches deep to chop but not bury heavy residues. The trash harrow or the mulch-treader can be used to break-up and spread heavy quantities of straw. They work best on dry, brittle residue and should only be used when a heavy trash cover exists.

Seeding machines equipped with double- or single-disc furrow openers will provide proper seed placement through not more than 2,000 pounds of well spread cereal residue. Stubble-mulch drills equipped with hoe-type or shovel-type furrow openers will operate satisfactorily through nearly 4,000 pounds of trash. The one-way disc combine seeder will also handle large quantities of stubble. Packing obtained by using a press-wheel carriage seeder or a packer attachment behind the one-way disc seeder is essential when seeding trash-covered fields.

The summer fallowing of land that has produced a normal or a below-normal crop requires careful use of tillage machines to retain maximum trash on the surface. The combine stubble should be cut as long as possible and the straw uniformly scattered by the spreader attachment. Use a subsurface cultivator for all tillage operations. Seeding may be done with either a double-disc press drill or a mulch-hoe drill. When summer-fallowing land that has produced above-normal crops use the combine straw-chopper attachment to reduce and spread straw. This is particularly advisable when harvesting flax. One or two discing operations may be used during the fallowing

and seedbed preparation period, particularly when weed control is difficult. Otherwise use the subsurface cultivator for tillage, the trash harrow or a mulch treader during seedbed preparation, and the mulch-hoe drill for seeding.

"Stubbling-in" land with normal or below-normal quantities of stubble and straw may be done with the one-way disc seeder and packer. Where extra tillage is required for weed control use the cultivator or disc followed by rod weeding if required. Either the double-disc press drill or the mulch-hoe drill can normally be used. Land with a very heavy stubble cover (4,000 pounds or more) will require extra effort to prepare a "stubbled-in" seedbed. A disc-type implement can be used to chop the straw and disc-in the stubble. A mulch treader, if available, can be usefully employed to complete the seedbed. The mulch-hoe drill should be used for seeding, otherwise additional tillage will be needed to prepare the seedbed for a double-disc drill.

Burning stubble, or windrowed straw, is not justified since equipment and procedures are available that will take care of any level of trash that may be encountered. Continuous use of the practice of burning increases the erosion hazard and will eventually reduce soil fertility.

Clod structure on fallow supplements trash cover as an erosion control aid. Timeliness of tillage with respect to soil moisture is a factor in maintaining some clod structure. Disc implements should not be pulled at a high speed in a soil that is readily pulverized. Chisel plows, and under certain conditions the duck-foot, heavy-duty cultivator and rod weeder, can be used to establish a cloddy condition. Where trash is inadequate or is lacking, the mouldboard plow is useful for producing erosion-resistant clods. However, sandy soils and clay soils should not be fall plowed.

Strip cropping has proved valuable, particularly when combined with trash cover. Narrow field strips reduce the spread of drifting from focal points in a field. Strips from 5 to 16 rods wide are recommended on sandy and clay soils. On loam, silt loam, clay loam, and silty clay loam, strips 16 to 20 rods or slightly wider have been successfully used. Strips should be at right angles to the prevailing wind, or, if conditions are suitable, contour stripping may be practised.

Good shelterbelts decrease wind velocity for a distance to the leeward of up to 20 times the height of the belt and for a short distance to the windward side. Increased crop yields to the leeward of shelter belts may be attributed to increased moisture conservation. In park belt areas adequate shelter belt strips should be left to prevent serious wind erosion.

Shelterbelts are planted at right angles to the prevailing wind and at a distance of 20 to 40 rods apart. Contour planting of shelterbelts, combined with grassed strips and grassed water runways, is useful for both wind and water erosion. Keep tree belts at least 8 to 10 rods from a road allowance to avoid blocking roads in winter and follow regulations with respect to planting belts next to highways. For information on trees and planting procedure, see the section on tree planting.

Cover crops to protect soil and provide fall pasture are used in moister areas including parts of the dark brown soil zone. Oats are seeded on fallow late in July at a rate of three-quarters to one bushel per acre. Overgrazing destroys protective value of the cover. On irrigated land a cover crop, seeded on sweet clover or canning pea land after the clover is plowed under or the peas are harvested, will protect the soil and provide fall pasture.

SOIL DRIFTING ON IRRIGATED LAND

Many cropping systems on irrigated land do not lend themselves to trash cover farming. Pasturing-off crop residues such as beet tops and corn stovers predisposes soil to drifting because of the trampling by cattle and sheep.

Fall irrigating and subsequent fall plowing when soil moisture is conducive to clod formation is recommended. Fall-plowed land should not be disced and harrowed. Fields unsuited to fall plowing, e.g., sandy and heavy clay soils, should be shallow chiselled to roughen the surface. Cover crops should be used where practical.

Emergency control should be started at the first signs of drifting to protect the fertility of valuable irrigated soils.

EMERGENCY MEASURES

1) Winter drifting can be controlled by shallow chiselling with a heavy-duty cultivator with every other shank removed. Light tool-bar cultivators may be severely damaged if used in frozen soil. One-way discs with three out of four pans removed make excellent listers for frozen soil. The use of chisel blades on the shanks of a wide-blade cultivator, or other methods of plowing light furrows every 6 to 10 feet, will help check drifting on a winter wheat field and save the crop from destruction. Spreading manure or straw on small focal points will frequently check soil movement.

2) Drifting of non-frozen soil can be checked by any tillage operation that produces a rough cloddy condition. Chisel plows and other cultivators may be used. Plowing furrows around a field at frequent intervals helps. Under severe conditions, listing is required. Lister furrows, formed with a one-way lister or a cultivator with alternate shovels removed and the remainder steeply pitched, should be 24 to 30

inches apart. If sufficient soil has been trapped to fill the furrows, the listing operation should be repeated.

SANDY SOILS

Sandy soils do not form weather-resistant clods and are very subject to drifting.

For grain production in the moister areas of the Dark Brown soil zone and in the Black and Grey Wooded soil zones, complete trash cover farming can be used. A cover crop will protect the fallow during the fall and winter preceding the main crop. A grass and legume mixture or grass alone, either as a permanent crop or in rotation, also is useful in these areas.

In dry regions seeding-down sandy areas to permanent pasture is strongly recommended. Continuous cropping to cereal grains requires the best use of moisture from snow trapped in the stubble and a careful weed control program. Strip cropping in narrow strips (5 rods or less) and maximum trash conservation must be employed where sandy soils are summer fallowed. In drought years trash cover from weed growth and the use of deep listing may be required to prevent or control erosion.

WATER EROSION

The problem of water erosion in Alberta demands consideration of principles governing erosion, survey of precipitation data, and assessment of damage and of control methods.

The principles governing water erosion are three: rainfall characteristics, field characteristics, and soil properties.

We are concerned not only with total rainfall but also with intensity. A soil can hold only so much water and the water can be absorbed only up to a certain rate. When that rate is exceeded or if intensity exceeds infiltration, run-off and erosion occur. Rain drops pulverize exposed soils, liberating clay, silt and fine sand particles to be carried away in the run-off.

Steepness and direction of slope, and the nature and amount of protective cover, determine to a large degree the amount of erosion.

With respect to soil, structure is the dominant factor because it determines infiltration rate and erodability. Soil structure in turn depends on the relative amounts of sand, silt, and clay (soil texture), the quantity and nature of organic matter, the chemical nature of the soil, and the method of handling the soil.

PRECIPITATION STUDIES

Average annual precipitation in Alberta's crop-growing areas varies from 13 to 20 inches, 70 to 80 per cent of which falls during the six months, April to September. Total rainfall in the crop-growing period is not as high as in some places and the erosion problem is therefore less acute.

Averages of rainfall for the crop-growing regions of the province are less than 3 inches in May, less than 4 inches in June, less than 3½ inches in July, and less than 3 inches in August. Usually the storms are well distributed and rarely are our soils filled to capacity.

The few records available indicate that rainfall intensities in Alberta are also low compared with those in areas where water erosion is serious. The record 24-hour rainfall at Edmonton over a 10-year period is 4.17 inches and Thorsby reported the provincial record of 4.83 inches one day in July, 1937. Many of the south eastern United States have reported storms delivering over 10 inches in 24 hours. In storms of short duration too our Alberta cloud bursts are mild by comparison. Record storms have delivered less than 2 inches in one hour but elsewhere as much as 5 inches or more have fallen in this period.

Since neither total rainfall nor rainfall intensity in Alberta are severe enough to cause conspicuous damage, there is a tendency on the part of farmers to disregard water erosion completely. This is bound to result in excessive run-off, gullying, and erosion of precious top soil.

SOIL LOSSES

The amount of soil lost by sheet erosion from the overall surfaces of our fields is small. However, where slopes are long and uniform and impervious layers in the soil prevent infiltration, severe sheet erosion has occurred. This has been observed in the Peace River area especially. In general the most serious problem in Alberta is the formation of gullies in more and more fields. These are a hindrance to cultivation, dangerous to operators, a weed trap, and represent large losses of soil and water. Closely related to prevention of water erosion is rainfall conservation. Control of run-off and erosion not only conserves rainfall and valuable top soil but also assists in preventing wind damage.

CONTROL MEASURES FOR ALBERTA

1) Follow a good crop rotation to build up the organic matter and fibre content of the soil. Include grass and legume crops, especially in the moister regions of the province. Avoid summer fallowing in the moister regions of Alberta except for control of weeds like couch grass. Maintain a trash cover if possible when land is not in crop. Avoid overworking and pulverizing the soil. When possible use implements such as the one-way, cultivator, rod-weeder, and blade weeder, which leave the trash on top and do not pulverize the surface soil. Conserve all crop residues. **Do not burn straw or stubble.**

2) Seed down waterways that are likely to wash, using a hay mixture including grass.

3) Keep steep slopes in permanent grass or tree cover. Re-grass and re-forest steep slopes where necessary.

4) Practice strip cropping across slopes of cultivated fields that tend to wash severely. Contour cropping may occasionally be required. Plant cultivated row crops across rather than up and down slopes that tend to wash. Plow and cultivate across rather than up and down slopes. A ridged surface left in the fall across a cultivated slope will tend to check spring run-off.

5) Grow cover crops or winter crops, when practicable, on fields that are likely to be damaged by spring run-off. Spread straw or barnyard manure on slopes where washing is likely to occur, and dam runways with straw, brush, stones, or other material.

MOISTURE CONSERVATION

Moisture is the main factor limiting crop production in the south and east central areas (Brown and Dark Brown soils). The average annual precipitation is about 13 inches with frequent dry winds reducing the effect of the rainfall. To the north and west (Thin Black soils) the average annual precipitation varies from 14 to 16 inches. Due to lower average temperature and less wind, each inch of rainfall is more effective here than in the Brown and Dark Brown soil zones.

Soils differ considerably in their capacity to store moisture. Clay soils can store more than twice as much as sandy soils. This, in part, explains the greater drought resistance of clay soils.

One purpose of summer fallowing is to store moisture for the following crop. The soil surface during fallow must allow for easy entry of water by maintaining trash cover and ridging the field parallel to slopes. Fallow land should be kept weed free to prevent loss of the stored moisture. Every inch of moisture conserved means extra bushels in next year's crop.

Good fallow will:

a) prevent weed growth by timely and proper cultivation

b) provide for the control of erosion as outlined on pages 17, 18.

c) assist in the control of insect pests, especially wireworms and cutworms. (See pages 85, 86.)

The depth of moist soil in a stubble field may be determined with an auger. The change from moist to dry soil is easily observed. Moist soil will "ball" when squeezed in the hand. Dry soil is lighter in color and is harder to bring up with the auger. In the Brown and Dark Brown soil zones less than 27 inches of moist soil at seeding time indicates a poor reserve, insufficient for a satisfactory crop in the average season.

Summer fallow to increase the storage of reserve moisture is needed within the Brown and Dark Brown soil zones and the Thin Black soil zone. On the other hand, summer fallow for moisture conservation should not be considered an essential practise on the Black or Grey Wooded soils. The yearly distribution of precipitation is more reliable within these latter areas where fallowing should be practised only for weed control or when breaking grass sod in a crop rotation.

SPECIAL PROBLEMS

Saline and Alkali Soils. — See section under Irrigation.

Solonetz Soils — These soils are otherwise known as burn-out or blow-out soils—terms that are descriptive of the native landscape in many areas where they occur. They are characterized by a dense layer or hardpan immediately below the top soil. This layer breaks into large, hard clods when dry and is very sticky when wet. Moisture penetrates this layer very slowly and the soluble salt content of solonetz soils is often great enough to interfere with normal crop growth.

Solonetz soils occur as irregular patches of varying size in association with normal soils. The most extensive area of such associations in Alberta is about 375 miles long and about 50 miles wide and extends from north-east of Edmonton to west of Medicine Hat. A large area of solonetz and associated soils also occurs in the extreme south-east corner of the province, occupying an area approximately 50 miles square. Other significant areas where solonetz soils occur are in the Peace River region and in the vicinities of Leduc, Clyde, Cardston, Coutts, and Chancellor.

In addition to their wide area of occurrence, solonetz soils have a wide range of chemical and physical characteristics. Thus, although these soils are considered to be inferior to normal soils, success of cropping varies from fairly good to poor. In areas of the Brown soil zone where solonetz soils predominate, profitable cropping may be limited to only those years when summer rainfall is ample and ideally distributed during the growing season. In areas of better moisture efficiency (Thin Black, Black, and Grey Wooded soil zones) solonetz soils are fairly productive if certain specific tillage and cultural practices are used.

The major problems associated with solonetz soils, particularly where the hardpan condition is severe, are those concerned with soil moisture. Poor drainage and

salinity can be serious problems when these soils are irrigated or in periods of unusually high rainfall.

Timing of cultivation according to soil moisture conditions is very important. This is particularly so in preparing that seedbed. If solonetz soils are worked when they are wet and sticky, the soil will puddle and upon drying will bake into large hard clods that are difficult to break down. If the soil is too dry, many large clods will be brought to the surface. In either case poor germination of seed may result because of the lack of a seed-moist soil contact. Rains that occur before the crop is up may puddle the soil and subsequent surface crusting may impede crop emergence. Either disc or hoe types of seeding equipment may be used but it is advisable to use packers that follow the drill runs. Power requirements for tillage are somewhat higher for solonetz soils than for normal soils because of heavier draft, the necessity of completing each operation while soil moisture conditions are optimum, and a frequent need for a greater number of cultivations to prepare a good seedbed.

The incorporation of organic matter by working in straw, stubble, and manure will help to improve solonetz soils. The first summer-fallow operation of the season should be carried out as early in the spring as soil moisture conditions permit. Either disc- or blade-type implements may be used although the disc tends to destroy surface trash, the maintenance of which is important where wind erosion may occur. Depth of working usually depends upon the depth of soil overlying the hardpan.

Cultivation deep enough to break up the hardpan, using chisel plows or spike-toothed cultivators has been practiced with moderate success where the hardpan is mild. Such operations should be done early in the fallow year so that the effect of bringing up hard clods does not interfere with seedbed preparation. Any beneficial effect of deep chiselling will be only temporary, however, unless considerable amounts of organic matter can be incorporated into the soil during this operation.

Peats — In Alberta, peat occurs mainly in the Grey Wooded soil zone, but there are numerous minor areas in the Dark Grey Wooded and Black soil zones. Many small areas have already been brought under cultivation. Peat covers an estimated 25 million acres in Alberta, but few of the great muskegs of northeastern Alberta will likely be reclaimed.

The peats are usually underlaid by clay or other soil material fine enough to hold the moisture in basins or flats, which permitted and encouraged the growth of sphagnum moss and other moisture-loving plants. Most of the Alberta peats studied have been classified abroad as high moor or moss peats, but they are commonly called muskegs in this country. Alberta peats, classified as lowmoor, sedge or grass peats, are usually shallow, rich in lime, dark in color, and relatively fertile. Chemically, Alberta peats differ widely.

In nitrogen content they range from less than 1.0% to more than 2.5%. Although relatively high in nitrogen, they frequently respond to nitrogen fertilization in Alberta.

Their phosphorus content varies less and is not very high compared with mineral soils. Peats reclaimed for crop production are frequently deficient in available phosphorus. The potassium content of some Alberta peats is very low, suggesting a need for potash fertilizers.

Alberta peats vary from about pH 4 on the acid side, to about pH 8.5 on the alkaline side. pH 7 is neutral. The calcium content varies from less than 1.0% to nearly 5.0%. According to some investigations peats in need of lime narrow down to those with pH values of 3.5 to 4.5. Those with 2.0% or more of calcium are not likely to require lime for crop production.

Experimental work with peats has not been carried on long enough in Alberta to make certain of the best methods of bringing them under cultivation. The first step naturally is to drain the land. However, it should be realized that the draining of peat bogs, like the clearing of forests, dries up reserve moisture in dry seasons and increases water erosion in wet seasons. In their undrained state peat bogs form natural reservoirs and feed the streams that would otherwise dry up in dry seasons. Peat bogs should not be drained unless the land is to be reclaimed for pasture or other crop production.

Muskeg, after it has been drained is sometimes burned to increase its productivity. Burning is likely to leave the field in a very irregular condition, or in the case of shallow peats, too little organic matter will be left for a good seedbed. Don't set fire to the peat. Many peat areas in Alberta have been seriously injured by excessive burning.

Freshly plowed peat land should be disced and, preferably packed to make a firm seedbed. Discing without plowing is often sufficient preparation for subsequent crops. Greenfeed such as green oats may be grown as the first crop, and later it should be possible to ripen early barley or other grain crops on some of this land. Frost damage to grain, potatoes, and other susceptible crops, is more frequent on peat soils than on adjacent mineral soils, because less heat is radiated from peats than from mineral soils on cold nights, and because peats commonly occupy the lower areas. Early ripening barley is probably the safest crop for grain production. It is likely that most of our reclaimed peat land

will eventually be seeded down to grass and clover, as this is the easiest way of handling such land. Brome grass and reed canary grass have produced good yields of hay on some Alberta peats. In a mixture of brome, timothy, alsike clover and alfalfa, the legumes were not well maintained. Legumes generally require good drainage and soil aeration, and peat soils are apt to become water-logged at times, not only because of their low-lying position, but also because of their high water-absorption capacity. Grasses generally can withstand temporary water-logging much better than legumes and often thrive on an abundant supply of moisture. Satisfactory yields of brome grass seed have sometimes been produced on Alberta peats.

Peats differ greatly in their ability to produce crops, and for this reason their fertilizer requirements cannot often be predicted without actual field trials. They vary greatly in reaction, and many moss peats are very acid and should respond to treatment with lime. When marl deposits rich in lime are conveniently located, this material might be applied to a part of the muskeg at the rate of, say, one ton per acre, and its effect could then be observed. Where reaction is satisfactory and yields are unsatisfactory the application of barnyard manure or commercial fertilizer is apt to prove beneficial. Profitable increases in early barley and hay have been obtained in many cases from the application of a complete fertilizer containing nitrogen, phosphorus and potassium, and sometimes from a fertilizer containing nitrogen and phosphorus, whereas in other cases no appreciable increases have been obtained.

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Cir. 19—Protect Prairie Soils.

Irrigation

EXTENT AND LOCATION

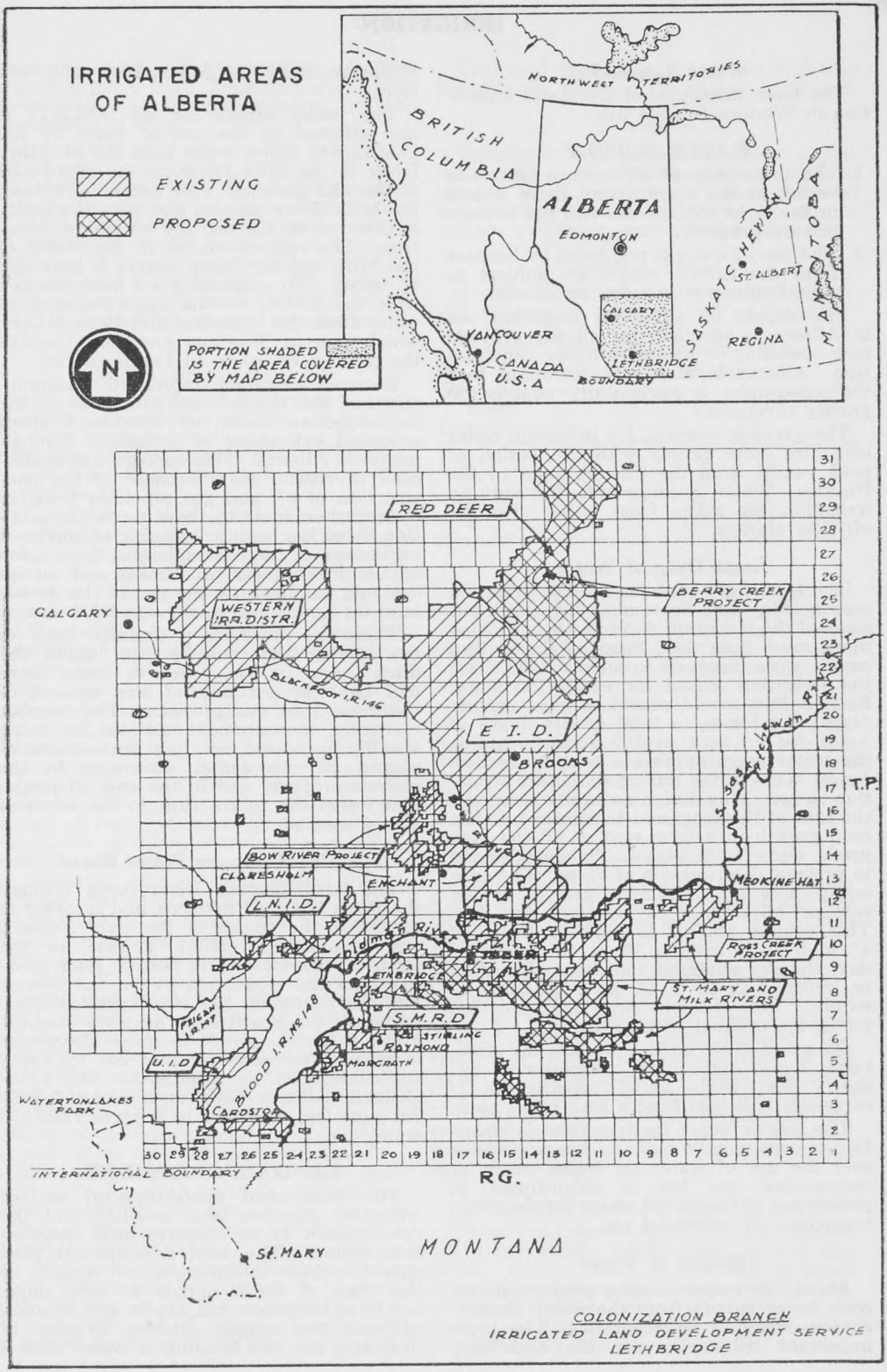
Irrigation in Alberta developed its first major project in 1901 when the Alberta Railway and Irrigation Company completed the main works to divert water from the St. Mary River at Kimball, Alberta, which provided irrigation for about 600 acres of land near Lethbridge and 3,000 acres in the Magrath District.

The Governments of Alberta and Canada and the Canadian Pacific Railway have developed the major irrigation projects in Alberta. Small projects have been developed by individuals and through the assistance of the Prairie Farm Rehabilitation Administration. At the present time, irrigation works are owned and operated by either the Governments or the farmers. The following table and acompanying map outline the location and extent of irrigation projects in the Province of Alberta:

Source of Supply	Project	Closest Centre	Constructed by	Year Dev.	Operated by	Approx. Acres Under Irrig.	Total
Bow	Bow River Proj. (Central Block)	Vauxhall	Can. Land & Irrig.	1920	P.F.R.A.	63,000	
		Hays	P.F.R.A.	1955	P.F.R.A.	30,000	
	(Blackfoot Reserve)				P.F.R.A.	5,000	
	Bow River Dev. (West. Block)	Enchant	Alberta	1958	Alberta	25,000	
	Western Irrig. District	Strathmore	C.P.R.	1911	Farmers	42,000	
	Eastern Irrig. District	Brooks	C.P.R.	1914	Farmers	200,000	365,000
Waterton River	United Irrig. District	Glenwood	Farmers	1924	Farmers	34,000	
Belly River	Mountain View Irrig. Dist.	Mountain View	Farmers	1932	Farmers	3,700	
	Leavitt Irrig. District	Cardston	Farmers	1943	Farmers	4,600	
	Aetna Irrig. District	Cardston	Farmers	1943	Farmers	8,300	50,600
St. Mary River	S.M.R.D. West Section	Lethbridge	A.R. & I.	1901-20	Alberta	82,000	
	Magrath Dist.	Magrath	Farmers	1926	Farmers	7,500	
	Raymond Dist.	Raymond	Farmers	1925	Farmers	19,000	
	Taber Irrig. District	Taber	Farmers & Prov. Gov.	1920 1950	Farmers	40,000	
	S.M.R.D. East Section	B. Island	Prov. Gov. & P.F.R.A.	1955	Alberta	122,000	270,500
Old Man River	L.N.I.D.	P. Butte	Farmers	1923	Farmers	96,100	
	S. Macleod Dist.	Macleod		1948		3,000	99,100
Other Sources	Ross Creek Irrig. Dist.	Med. Hat	P.F.R.A.	1949	Farmers	2,100	
	Berry Creek Irrig. Dist.	Wardlow	P.F.R.A.	1938		3,000	
	Little Bow	High River	Farmers			200	5,300

In addition to the above, there are about 650 private licensed irrigation schemes with a total area of approximately 75,000

Total number of irrigated acres in Alberta 865,500



COLONIZATION BRANCH
IRRIGATED LAND DEVELOPMENT SERVICE
LETHBRIDGE

Water Legislation

The basic principles of the water legislation in Western Canada are:

WATER SUPPLY

1. The ownership of all surface waters is vested in the Crown, and these waters or the right to their use can not become private property.
2. The use of water is regulated by licenses from the Crown, which are subject to cancellation for non-use or misuse.

The supply of water for irrigation use in Alberta is adequate for all the projects now operating or presently under construction. Alberta is also very fortunate that the topography is particularly adapted to gravity diversion.

The greatest demand for irrigation water coincides quite closely with the period of peak runoff from the melting snow of the Rockies. Water requirements for autumn irrigation are taken from either river or off-river storage.

Legal Duty of Water

The legal duty of water for the irrigation season (May 1 to September 30) is 18″, but some of the irrigation districts have diverted much more than this. Some of the earliest canals were designed to supply 1 c.f.s. for the irrigation season for every 150 acres. Such a flow would provide almost exactly (excluding losses) a total of 24″ depth of water for an area of 150 acres providing the water users applied a continuous flow for 24 hours a day during the entire irrigation season. This design naturally restricted the rate of flow required to sustain uniform crop growth in a farm unit as all the area needs water in a reasonably short period to prevent deterioration of crops. The generally accepted minimum use is at the rate of 2.5 c.f.s. or 5 acre-feet per day. This volume applied to land in depths of 4″ to 6″ will irrigate 10 to 15 acres per day, thereby enabling 160 acres of land to be irrigated in 12 to 16 days. This rate of required flow is about twice that provided for in the original regulations.

On many of the earlier projects the structures were inadequate. Experience has shown that while sound construction is expensive it is best from a long range view.

The use of water for irrigation is classified as consumptive use and has preference over the use of water for water power or recreational use but is subordinate in preference to the use of water for domestic, municipal, or industrial use.

Source of Water

All of our major existing projects derive their water supply from the South Saskatchewan River or its tributaries. The more important tributaries are the Old Man, Waterton, Belly, St. Mary, Highwood, and Bow.

The water supply for the S.M.R.D. is also affected by the use of water by the U.S.A., who divert water from the St. Mary River to the Milk River on the south side of the 49th parallel. This water flows down the Milk River channel and is subsequently re-diverted in the vicinity of Havre, Montana. The apportionment of the water of the Milk and St. Mary Rivers is governed by treaty. No agreement has been reached with the U.S.A. on the apportionment of water from the Waterton and Belly Rivers, which rise in Montana and flow through the prairies en route to Hudson's Bay.

Because irrigation represents consumptive use, the downstream provinces on the Saskatchewan basin are concerned about proposed extensions of irrigation developments in Alberta. This concern has moderated in recent years because of the construction of oil and gas pipelines bringing hydrocarbon fuels to those areas. In addition there has been a lessening of emphasis on the use of the Saskatchewan River delta at Les Pas for fur production and an increasing emphasis on the use of this fertile land for agriculture by diking and drainage.

There is, however, a definite limit to the acreage that can be put "under the ditch", and in the years to come there will be close scrutiny of the amount of water used in this province. The number of water measurement stations is being steadily increased not only on sources of supply but on actual diversions to the various projects, and in the case of irrigation works the return flow to the rivers is also measured.

Prairie Provinces Water Board

The Saskatchewan River flows through the three Prairie Provinces, and in order to apportion the waters of the river a board was established (1950) known as the Prairie Provinces Water Board. Each province has one representative on the Board, and the Dominion has two representatives. Although the Board is an advisory organization, it has the power to make allocations of water after each province has approved the allocations by appropriate Orders-in-Council. Alberta has been allocated 2,237,-234 acre-feet of water to irrigate 1,256,453 acres.

LAND DEVELOPMENT

The economical application of surface irrigation requires land levelling and the development of an effective farm distribution system. The land development plan should include information and designs of the size of fields, grade of land slope, length of irrigation run, grades and location of head and supply ditches, location of drainage, size and location of water control

structures. Assistance is available to the farmers through the Alberta Department of Agriculture, Colonization Branch, in the preparation of a plan.

The benefits are: (1) a uniform application of water; (2) earlier seeding; (3) uniform and higher yield; (4) water continuously under control, which reduces waste of water and land; (5) erosion control; (6) prevention of salinity, alkali, and waterlogging; (7) low labour requirement; (8) high irrigation efficiency; (9) greater choice of crops; (10) increased land value; and (11) improved general appearance of farms.

Land Preparation

Land levelling should be arranged well in advance of operations. The most suitable time for land levelling is from May to September. Enough time should be allowed to cultivate, float and fall irrigate the levelled land.

Summerfallow land is the most suitable for land levelling as trash impedes earth moving and floating operations to a certain extent. Flax stubble is especially cumbersome as it balls up and, as a result, earth moving machines take longer to load. Stubble and alfalfa land should be chiselled or cultivated to facilitate loading operations prior to land levelling.

Following land levelling operations, cut areas should be chiselled at least 3 times to a depth of 6 to 8 inches to increase infiltration and help reduce the effect of the packing action of heavy earthmoving equipment. Levelled fields should be prepared for fall irrigation by floating and the use of corrugations to prevent erosion and ensure complete water coverage. Fall irrigation will assure a moisture supply for the following spring, help settlement of fill areas, and control soil drifting.

Permanent crops should not be planted the first year following heavy earth moving as trimming is often required after irrigating. Some fill areas may settle and some cut areas may swell. The spring operation should include re-working, floating and seeding to an annual crop. The land can be border dyked and if floating is not required after the crop is harvested, the stubble can provide protection for the seeding of forage crops.

Barnyard manure should be applied at the rate of at least 10 tons per acre. In addition, with cereal crops the first year apply 100 lbs. of 16-20-0. Established legume crops should receive 100 lbs. of 11-48-0 in the early spring. If barnyard manure is not available a green manure crop of innoculated sweet clover may be grown. Where only fertilizer is to be used, apply 200 lbs. of 27-14-0 for cereal crops the first year and if legumes are grown the second year, apply 100 lbs. of 11-48-0.

Barnyard manure and legumes will also improve the physical properties of the soil.

Structures

Structures for control in checking, diverting, or dropping of water can be built of treated wood, concrete, or other material and properly located in ditches to ensure savings in labour, water and land.

Syphon Tubes

Syphon tubes and similar equipment provide control of water applied to the land.

Volume Flow Per Syphon Tube in Gallons Per Minute

Head Tube Diameter	3"	4"	6"	9"
¾"	4	5	6	7
1"	6	7	9	11
2"	27	32	41	50
4"	106	122	153	200

Water Application

Water application should be made on each irrigation run by starting with a maximum non-erosive flow, then, after about three-quarters of the run is wetted (which should be one-quarter of the total time for irrigating the run), the flow is reduced to an amount that will disappear into the soil through the full length of the run, thus reducing run-off to a minimum. Several syphon tubes, for example, can be used to begin with on each run, then reduced to only one or two at the same time that new runs are started.

METHODS OF IRRIGATION

The method of irrigation depends upon the crop to be grown, the type of soil, the slope of land, and the amount of available water.

Free Flooding From Contour Ditches

Free flooding from contour ditches is used on rough land with variable slopes where better methods cannot be used. The spacing of ditches and the handling of the water by the irrigator are very important. Contour ditches drop at the rate of 1 to 3 inches per 100 feet of length and are spaced from 75′ to 300′ apart. The wider spacing is recommended for heavier soil and flatter slopes.

Run-off Flooding Behind Dykes

Dykes built across flat draws collect run-off water which floods areas behind the dykes. Excess water is released to flood areas farther down the draws. Spring run-off is the main source of supply. This method is used particularly on ranches in providing hay meadows.

Border Ditches

Border ditches running parallel down slope are used on gentle slopes. The careful spacing of ditches and the length of run determines the effectiveness of this method.

Border Ditch Irrigation

Soil Type:	Sand	Loam	Clay
Length of Run (ft.)	200	300-400	400-500
Ditch Spacing on Uniform Slopes (ft.)	100	150	200-250
Ditch Spacing on Slightly Irregular Slopes (ft.)	75	100	100-200
Ditch Spacing on Irreg. Slopes (ft.)	50	50 - 75	50-100

Furrow Irrigation

Furrow irrigation is used for all row crops with slopes not exceeding 2 per cent. Where slopes exceed 1 per cent, cross slope or contour furrows are suggested to reduce the furrow slopes.

Stream size (maximum non-erosive) for each furrow depends on type of soil and length of run. Maximum non-erosive streams may be determined as follows: 10/S where S is slope of the furrow in per cent. Syphon tubes are recommended to control the size of furrow streams.

Length of Furrow Runs

Soil Type	0.2% to 2% Slope
	feet
Sand	400 - 250
Loam	880 - 400
Clay	1,320 - 880

Corrugations

Corrugations are small furrows used for broadcast or close-seeded crops on lands of varying topography. This method is particularly useful for irrigated pasture crops on steep or irregular slopes or if only a small stream of water is available. Slightly smaller stream sizes and shorter lengths of run are used for corrugation irrigation as compared to the furrow method.

Border Dykes

The border dyke method of irrigation is most efficient requiring the least amount of labour, yet irrigates the land at the fastest rate. It is highly recommended for all close-seeded crops, especially hay and pasture. Only one head ditch for each field is required for irrigating by this method. The dykes are 4″ to 12″ high and 2.5 feet wide, being located from 16 to 50 feet apart running parallel down the slope. The space between each pair of dykes is called a border which provides the irrigation run. Dyke spacing depends on type of soil, steepness of the land, available stream size and cross slope.

Border Dyke Irrigation

Slope Group (%):—		0.2 - 0.6	0.7 - 1.0	1.1 - 2.5
Sand	Stream Size (c.f.s.):	5.5 - 3.0	2.5 - 1.5	1.2 - 1.0
	Lengths of Run (ft.)	750 - 520	450 - 380	360 - 250
Loam	Stream Size (c.f.s.):	5.5 - 4.5	4.5 - 2.5	2.0 - 1.1
	Length of Run (ft.):	1800 - 1250	1200 - 1000	950 - 600
Clay	Stream Size (c.f.s.):	6.0 - 3.0	3.0 - 2.5	2.0 - 0.9
	Length of Run (ft.):	2640 - 2500	2400 - 2200	2150-1430

WATER MEASUREMENT

Water measurement is easily made with the provision of one or two well-installed measuring structures in the farm ditches. It is important to know how much water is being applied on each irrigation run during any period of time.

1 cu. ft. per second =
1 acre inch in./hour (approx)
1 acre foot in 12 hours (approx)
450 U.S. gals. per minute (approx)

1 cu. ft. = 7.48 U.S. gallons =
6.23 Imperial gallons

1 U.S. gallon = 0.83 Imperial gallons

Acre-foot — An acre-foot is a volume of water sufficient to cover an acre 1 foot deep. It is equal to 43,560 cubic feet or 325,851 U.S. gallons.

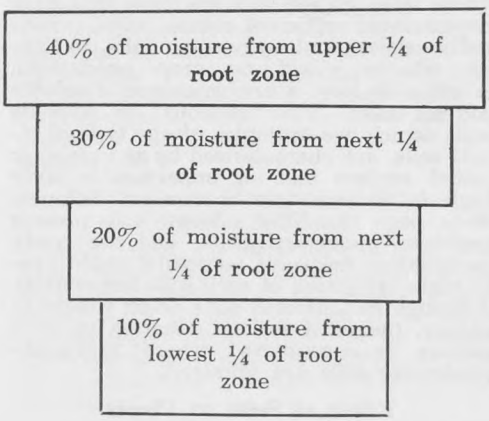
Acre-inch — An acre-inch is a volume sufficient to cover an acre 1 inch deep.

1 acre-inch = 27,154 gallons (U.S.) = 3,630 cubic feet

Cubic foot per second (c.f.s.) — This is a rate unit and represents an exact and definite quantity of water per second. It is the equivalent of a stream 1 foot wide and 1 foot deep flowing at an average rate of 1 foot per second.

SOIL MOISTURE RELATIONS

Root Zone: The root zone or area of soil that contains the plant roots is about 2 feet for shallow-rooted crops, 4 feet for most normal crop roots and as much as 6 feet for the roots of alfalfa. The following table shows the relative use of moisture by plants from varying depths of soil —



Plant Use of Moisture: Plant use of moisture for most crops is about 0.15 to 0.3 of an inch of water per day during the normal growing season. The greatest use is during the peak growth period and hottest days.

Readily Available Moisture: This is the moisture in the soil that is available for plants to use. It is about one inch for sand soils, 2 inches for loam soils, and 2½ inches for clay soils per foot of root zone depth. For example, a 4-foot root zone of loam soil can be expected to hold approximately 8 inches of readily available moisture. Following is a table showing the water-holding capacities of different textures of soil —

Soil Texture	Total Available Soil Moisture (Inches of water held per foot of soil depth)
Coarse sand	0.50 - 0.75
Sandy loam	1.00 - 1.50
Silt loam	1.50 - 2.50
Clay or silty clay	2.00 - 3.00

Time to Irrigate: Never let the soil dry out to the point where the plants suffer from lack of water. By the time plants show signs of injury they have needed water for about a week, so the time to irrigate is best determined by the amount of moisture in the soil. Fields should be irrigated when the upper foot of soil contains about one-half of its available moisture. With a little experience the irrigator can tell the amount of water needed by feeling the soil. The following can be used as a guide for determining the need for irrigation for any except very sandy soils: Dig down about 6 inches to a foot, take a handful of soil and form a ball with firm hand pressure. The ball of soil is then tossed a foot into the air and allowed to drop on the palm of the hand. If the ball does not crumble within five tosses more than half of the available moisture is in the soil, and irrigation is not needed. If the ball crumbles during the tossing, between one-quarter and one-half of the available water is left in the soil and irrigation should be started. If a ball cannot be formed, the soil has been allowed to become too dry and irrigation should be started immediately.

Fall irrigation of forage crops is recommended to lessen the danger of winterkilling. Fall irrigation of fields to be seeded the following spring ensures an adequate supply of moisture for germination. The need for irrigation in the spring is usually delayed until after seeding operations are completed.

Irrigating Crops: See references. The amount of moisture in the soil determines the time to irrigate, and frequent soil sampling is the way to keep up with the water requirements of the crop. However, certain general recommendations can be made for specific crops, bearing in mind that weather conditions influence the need for irrigation. The following recommendations assume that a good irrigation has been given in the fall so that the soil has gone through the winter well supplied with moisture. All irrigations should fill the root zone to capacity. ALFALFA and Alfalfa Mixtures—Irrigate when the alfalfa is 10 to 12 inches high and again immediately after each cutting has been removed. Irrigating after the last cutting constitutes the recommended fall irrigation. PASTURES — Pastures require frequent irrigation. Rotational grazing should be practiced, and the time of irrigation will depend on the

length of time the stock are left on each field. Whenever the animals are moved, that portion of the pasture should be irrigated immediately. Pastures should be irrigated every two to three weeks. SUGAR BEETS—Sugar beets require frequent irrigations started soon after thinning, applying enough water each time to connect up with the moist subsoil. Three or four irrigations are usually required. GRAIN — One irrigation at the shot-blade stage is usually sufficient. POTATOES—Potatoes need frequent light irrigations about every three weeks. If the soil is allowed to dry out between irrigations, reduced yields and lowered quality will result. No water should be applied for about a month before harvest. CORN — Corn is sensitive to too much water. Two irrigations, the first when the corn is about 2 feet high and the second at tasselling, are usually sufficient. CANNING PEAS—Canning peas should receive a good irrigation when about 6 to 8 inches high and a lighter application shortly before harvest.

Self Check on Irrigation Efficiency: An examination 48 hours after an irrigation of samples from each foot of soil to a depth of 5 or 6 feet will indicate whether or not enough water or too much water was applied. If the moisture in the soil is evenly distributed to the depth only of the root zone, then the irrigation is very efficient. If dry areas occur in the root zone, then the application was insufficient. If the soil is excessively wet below the root zone, then too much water was applied. Numerous checks with a soil auger should be made in each field. Corrections in irrigations, according to the findings of this checking system, can then be made at the next irrigation.

IRRIGATED FARM MANAGEMENT

Irrigation farming involves a number of special management problems peculiar to this type of agriculture.

Higher per acre capital investment and operating costs, exist as compared to dry land farming in the same area. Good irrigated farm land sells for a higher price than dry land in the same district. More machinery is required when compared with the same acreage of dry land. Additional labour is required to more intensively cultivate, irrigate and harvest crops on irrigated farms and to handle the necessary complement of livestock.

A more complicated balance exists between soil, fertility, water and plants when optimum quantities of water are applied to the soil. Special attention must be given to the management of the soil, including the use of soil-building crops, the use of manure and mineral fertilizers. It is also important to apply the right quantity of water to each kind of crop to obtain maximum yields. Good drainage of the soil becomes an important management problem. Lack of drainage can cause reduced yields, deterioration of land, and costly reclamation.

The necessity for higher gross and net returns per acre for smaller acreages farmed makes necessary the production of specialized crops. This is usually coupled with the growing of legumes and forage crops to maintain fertility, the growing of feed grains, and the feeding of livestock including dairy cattle. Where specialized crops cannot be marketed, the production of legumes, forage crops and cereal grains can most profitably be combined with one or more livestock enterprises. This is the most satisfactory way to ensure a readily available market for these crops. Intensively managed cultivated pastures are playing an increasingly important role in successful irrigation farming.

SOIL SALINITY AND DRAINAGE

Occurrence of Saline and Alkali Soils

When neither surface nor ground water drains away satisfactorily, concentration of the soluble salts near the soil surface results because of water evaporation. There are two distinct types of soil formed as a result of this salt accumulation — saline soils and alkali soils. Saline soils are those that have accumulated sufficient soluble salts, principally calcium and magnesium salts, to have an adverse effect on crop production. Alkali soils have a predominance of soluble sodium salts. The "blowout" or solonetz soils, which are examples of one type of alkali soils, are characterized by an uneven or pitted surface and an impermeable layer high in sodium (see section on Solonetz Soils, page 19). Most solonetz soils present problems under irrigation, and the costly reclamation measures necessary would likely make irrigation of such soils impractical. Although salt-affected soils occur widely in nature, the most serious situation in agriculture is encountered where previously productive soils are salinized.

Effect of Salts on Plants

The effects of the presence of excessive amounts of soluble salts on crop production are noted in poor stands, uneven growth, poor yields, and bare spots. Plant growth in these areas is retarded or prevented by the reduction of water uptake, or by some direct chemical or toxic effect. In addition, an alkali soil usually is in such poor physical condition that soil structure, permeability, and aeration are not favourable for growth. These effects are particularly critical when the plant is germinating and therefore it is difficult to establish a stand under such circumstances. Salt concentrations in the soil can be measured, and from these measurements it is possible to predict or account for salinity effects on plant growth in the field. Then changes in crops

planted or in cultural operations can be made if necessary.

Source of Salt Accumulation

Salts are present in the virgin soil, varying in concentration, in chemical composition, and in depth of occurrence with the soil type and with the rainfall pattern of the area. Water re-distributes the salts in ways varying with the soil type, topography, and other factors. Some salt is invariably present in irrigation water, and so salts are added to the soil. The major irrigation districts in Alberta are fortunate in having a source of good quality irrigation water, low in salt content, diverted from the mountain streams. Water from wells, minor streams and ponds may have a much higher salt content and should be tested for quality for irrigation in the laboratory before use.

Soil Salinity Changes With Irrigation

Surveys have shown that under favourable conditions most of the salts originally present in many soils developed for irrigation to date in southern Alberta have been moved by the applied irrigation water to depths below the soil root zones. Salinity and water-logging problems have arisen mainly in certain areas where there are unfavourable conditions of inadequate drainage of surface waters, and high groundwater levels caused by over-irrigation and by seepage from canals, laterals, and head ditches. Evaporation of ground water is then increased with a corresponding increase in surface-soil salinity as the salts accumulate.

Emphasis on Measures to Prevent Soil Salinization

Most irrigated soils in Alberta have relatively tight subsoils which greatly restrict the ready movement of excess ground water. As a result, the removal of excess ground water through the soil by natural drainage is slow, and the removal by artificial subsurface drainage is difficult and expensive.

Salinity problems and drainage requirements in irrigation can be minimized by:

1. A careful selection of the lands to be irrigated, especially from the standpoint of soils and topography.
2. The provision of drains for excess surface water.
3. Lining canals, laterals, and head ditches where necessary to minimize seepage losses.
4. A knowledge of crop water requirements and the amount of water that can be stored in the soil and made available to plants, and the application of that knowledge in good irrigation practices to waste as little water as possible through the soil.
5. Suitable irrigation layouts and land preparation including land levelling.

Improving Salty Lands

Soil analyses and observations of groundwater levels and other field conditions, are necessary to diagnose the problems that arise in salt-affected areas and to determine remedial measures. To improve salty lands, an excess of water must be applied to wash the salts down and out of the soil root zone. There is no chemical treatment that will neutralize the salts, although, on alkali soils, some amendments such as gypsum may be helpful in addition to the washing. Usually it will be necessary to supplement the natural soil drainage with covered tile or open drains to remove the excess subsurface water and salt and transport them out of the area. Both types of drain have been shown to be effective. Many irrigated soils in Alberta have limitations with respect to both depth and permeability. For this reason, and also because of the cost, comparatively few installations of open or tile drains have been made in Alberta for subsurface drainage, and only limited data are available on their performance. Experimental work on the depth and spacing of drains is being undertaken, and observations are being made on field installations.

Farming Salty Lands

Where it is not considered feasible to lower materially the soil salinity levels, any of the following practices may be helpful in keeping lands in production.

1. The ploughing-down of farm manure, green manure, or crop residues.
2. Planting so as to avoid salt build-up around the seed. The soil can be ridged and the seed planted near the base. The salt migrates to the top of the ridge leaving a zone of lower salt concentration, which makes conditions for germination more favourable near the base.
3. More frequent light irrigations to keep plants supplied with readily available moisture.
4. The selection of crops most tolerant to the salt condition during germination and growth.

Below are some of the common field crops grouped according to their tolerance to salts. These groupings have largely been made on the basis of tests in other countries. They are considered, however, to be generally valid for local conditions. Differences in the salt tolerance of plant species will be encountered.

High Tolerance

Tall wheat grass	
Slender wheat grass	Sugar Beets
Rape	Garden beets
Barley	Asparagus
Bird's-foot trefoil	Spinach

Moderate Tolerance

Crested wheat grass		Reed canary grass
Orchard Grass		Wheat, rye oats
Sweet clover	Flax	Potatoes
Alfalfa	Sunflower	Peas
Brome grass	Sweet corn	Tomatoes

Low Tolerance

White Dutch clover	Ladino	Field beans
Alsike clover	clover	Strawberries
Red clover	Red Top	Green beans
	Timothy	

Because of the complexity of salinity and drainage problems, the costs involved, and the need for a measurement program, farmers are urged to seek technical assistance. Inquiries should be directed to the irrigation district concerned or to the Provincial or Federal Departments of Agriculture.

REFERENCES :

Department of Agriculture, Ottawa.
Pub. 509—Use of Irrigation Water on Farm Crops.
Pub. 1152—Growing Irrigated Crops in Southern Alberta.

Cultural Practices and Crop Sequence

THE BROWN SOIL ZONE

Low annual precipitation and high seasonal evaporation characterize much of the brown soil zone. Farming here must make best possible use of the available soil moisture, and only the better soil types should be considered arable. Most of the arable soils lie in the western half of the zone where rainfall is between 13 and 14 inches annually. Even on the good soils the farm unit should be larger than in most other parts of the Province and handled as efficiently as possible.

Choice of dry land crops is limited. The major cultivated crop is spring wheat, and most farmers have adopted a wheat-fallow rotation. Some barley, flax or mustard seed may be grown in place of wheat but ensure that enough stubble remains to protect the soil from drifting during the fallow year. (See Soil Drifting, page 16.) Flax is a poor weed competitor and should be seeded only on clean land. Mustard should be grown preferably under contract with a reputable seed firm. On sandy soils and light loam soils fall rye is a suitable grain crop. Near the western boundaries of the brown soil zone when stubble land has a depth of over 27 inches of moist soil at seeding time, some stubble may be recropped rather than fallowed.

Although little grass has been grown to date on cultivated land in this zone, considerable permanency, through maintenance of fertility, may be attained if grass is grown for a 4- to 5-year period during each 12- to 15-year cycle. In most parts of this zone, crested wheat grass, seeded into clean stubble and used for hay or pasture, has been most satisfactory. In the northern section of the brown soil zone, brome grass, alfalfa, and crested wheat grass have been grown successfully for seed production. Mixtures of brome and alfalfa or crested wheat grass and alfalfa have been grown for forage.

Early cultivation of fallows with a combination of well adjusted disc- and subsurface-type tillage implements provides for best weed control and moisture conservation consistent with safety against soil drifting. A properly adjusted one-way disc. a blade cultivator, and a rod weeder have proved useful for normal fallow operations.

Wherever possible, at least some livestock should be kept to utilize non-arable grassland, cultivated grasses from rotations and sparse crop growth during drought years. These practices lend a measure of stability and permanency.

THE DARK BROWN SOIL ZONE

The soil and climatic conditions in the dark brown soil zone permit a wider variety of crops and cropping practices than in the brown soil zone. Along the border of these two zones the system of farming most likely to succeed is similar to that used in the better parts of the brown soil zone.

This is primarily a wheat-producing area and every effort must be made to maintain its productivity at a high level through proper cropping practices.

A rotation of wheat-wheat-fallow is most commonly used and experimental results at Lethbridge indicate that returns from this rotation often are better than from the wheat-fallow system. Continuous cropping to wheat has not been economically practical because of drought years when no crop was obtained. Barley and oats may replace wheat in most areas and often serve as a second or third crop after fallow. Flax produces good yields in the central and southern parts of this zone but to avoid disease infestation, it should not be grown two years in succession on the same land. Durum wheats of good quality may be grown in the south end of the zone. In the area south and west of Iron Springs, winter wheat may replace spring wheat in

most rotations. Commercial mustard, best grown under contract, does well in the south part of the zone. Sunflowers, also best grown under contract, are usually late-maturing but have produced satisfactory yields under careful cultural practices."

Cover crops of wheat, oats or barley, seeded during July, provide needed protection to fallow on soils subject to drifting in the central part of the dark brown soil zone.

Periodic seeding-down of cultivated land to grass or grass-legume mixtures, thereby extending the rotation period, is desirable. Inclusion in the grain crop of sweet clover for green manuring the following year appears to be beneficial where annual precipitation exceeds 16 inches.

Good trash-cover fallow prepared early in the season and maintained through the summer with a combination of disc and subsurface tillage implements generally provides for best weed control and moisture conservation consistent with safety from soil drifting. Plowed fallow cannot be recommended for the chinook area of this zone.

The inclusion of livestock and forage crops tends to add stability to farms in this zone.

BLACK SOIL ZONE

Because of their greater moisture efficiency the black soil areas permit the use of more intensive cropping systems. A full year of summerfallow is costly and not necessary for moisture conservation, especially in the moister parts. However, it is used to some extent for the control of persistent perennial weeds—See section on "Weed Control", page 34.

The moister of the deep black soils of this zone lend themselves more to mixed farming and the use of longer rotations involving the growth of coarse grains and forage crops, rather than to straight grain production. Barley and oats are the best grain crops in the moister parts of the region, while grass-legume mixtures give the greatest forage yields. A "partial" summerfallow in the year of breaking out of sod is usually employed.

The length of the rotation and the proportion of grain to forage depend on the operator's requirements for livestock feed and upon the local soil condition. The value of grass-legume mixtures for the improvement of soil tilth, the control of erosion and the suppression of weeds has been amply demonstrated. Based on productivity, a brome-alfalfa mixture is best suited to these soils when left down for a period of 3-5 years.

The beneficial effects on productivity of the mixed farming type of rotation over the straight grain rotation are clearly illustrated by the results presented below, from a comparative study conducted at Lacombe over a 35 year period.

	Rotation "C" Wheat, wheat, fallow	Rotation "O" Potatoes, wheat, oats, fallow, wheat, hay, hay		
	Yield of grain in lb./acre of rotation	Yield of crop in lb./acre of rotation		
Period		Grain	Hay	Potatoes
1923-32	876	801	1,012	1,944
1933-42	615	906	913	2,136
1943-52	862	1,076	755	2,757
1953-62	850	825	556	1,964

Where forage crops are grown for soil improvement alone, a shorter rotation having 3-4 years of grain with sweet clover in lieu of fallow may be used to attain similar results. The sweet clover could be taken off as hay or plowed down as green manure with equal results.

In the drier portions referred to as the thin black soils, grain production, chiefly wheat, predominates. In this area the summerfallow is used extensively, both for weed control and moisture conservation. A grain-fallow rotation with periodic seeding down to forage is a more pratcical type of cropping system for this area. (See references.)

GREY WOODED SOIL ZONE

Forages are essential to productivity of grey wooded soils. A number of legumes including red clover, alsike and sweet clovers and alfalfa may be grown alone or in combination with various grasses.

The moister regions of this zone are generally very favorable to crop production. Summerfallow should not be used except for the control of weeds that can not be controlled economically by other means.

Two to three years of legume or legume-grass and two to three years of grain constitute the main rotations on these soils. A short rotation of grain seeded down, legume plowed down as green manure and grain may be desirable to more quickly improve soil that has not previously been sown to legumes. After several rounds of this rotation, a longer, more permanent rotation could be established.

A number of grey wooded soils of West-Central and North-Central Alberta are sulphur deficient. On these soils the use of sulphur-bearing fertilizers on legumes is necessary to obtain the full benefit of the legume crop. Results from the University Soils Department plots at Breton for the period 1930-61 clearly shows this effect.

Fertilizer	Wheat after fallow	Wheat after clovers
None	14.9 bu.	13.1 bu.
Sulphur (21-0-0)	20.0* bu.	30.0 bu.

*Increase due primarily to nitrogen rather than sulphur.

The wheat yielded less after clovers than after fallow when no sulphur was applied. When sulphur was applied, the wheat after clovers yielded 14.3 bushels per acre more than wheat after fallow. For more details on sulphur and other fertilizers on these soils see page **14** on Soils, Zonation and Fertility. (See references.)

IRRIGATED SOILS

Irrigation farmers have ample opportunity to use well-planned rotations because of the wide choice of crops that can be grown and the assurance of an adequate supply of moisture. The choice of crops is entirely up to the farmer, although perhaps limited in some cases by the availability of contracts for certain of the specialty crops. Summerfallow has no place in irrigated agriculture except when a very serious weed problem or land-levelling program may justify its use.

The livestock farmer should grow forage crops in his rotations. Alfalfa has proved a very valuable crop in improving the fertility and physical conditions of the soil. Livestock provides an outlet for such unmarketable products as beet tops, corn stovers and pea vines. It also supplies manure which is by far the best fertilizer. Manure should be applied to the fields in early fall and plowed under to enable it to decompose as completely as possible before the following crop is sown. The most remunerative crops, such as sugar beets, should follow on the manured fields. Farmers who do not keep livestock should plan to grow a legume crop for plowing under as green manure.

Barnyard manure, green manure, and commercial fertilizers build up fertility, so that succeeding crops will benefit. It is well to plan the fertilizer program in such a manner that the greatest net returns per acre can be expected from year to year. For example, sugar beets should be grown on manured fields as this crop responds well to the application of barnyard manure. Commercial fertilizers should also be applied with sugar beets and canning crops as these will usually give the greatest returns. If cereal crops follow, they will benefit from the residual manure and fertilizer that are in the soil and may not require additional fertilization. See Fertilizers, page 8.

The five rotations outlined are types that may be followed in the irrigation areas.

1. Very intensive farming, sugar beets, canning crops and forage crops.
   (1) Canning peas — 50 lbs. 11-48-0 — manure stubble and plow under in the fall.
   (2) Sugar beets — 100 lbs. 11-48-0.
   (3) Canning corn — 100 lbs. 16-20-0.
   (4) Soft spring wheat as companion crop for alfalfa or alfalfa-brome mixture.
   (5) Hay 1.*
   (6) Hay 2.
   (7) Hay 3.
   (8) Potatoes—100 lbs. 11-48-0.

*If alfalfa alone, 100 lb. 11-48-0 in early spring. If alfalfa-brome, 100 lb. 27-14-0 in early spring.

2. Sugar beets and hay crops.
   (1) Soft spring wheat as companion crop for alfalfa or alfalfa-brome mixture.
   (2) Hay 1.*
   (3) Hay 2.
   (4) Hay 3.
   (5) Soft spring wheat or other grain—manure stubble and plow under in the fall.
   (6) Sugar beets—100 lbs. 11-48-0.
   (7) Sugar beets—100 lbs. 11-48-0.

*If alfalfa alone, 100 lb. 11-48-0 in early spring. If alfalfa-brome, 100 lb. 27-14-0 in early spring.

3. Cash crops without forage crops.
   (1) Canning peas—50 lbs. 11-48-0.
   (2) Potatoes—100 lbs. 11-48-0.
   (3) Sugar beets—100 lbs. 11-48-0.
   (4) Grain and sweet clover.
   (5) Plow sweet clover for green manure about May 20 and plant canning corn—100 lbs. 16-20-0. (If manure available, plow under with pea stubble.)

4. Irrigated pasture with limited contract crops.
   (1) Grain.
   (2) Pasture seeded in stubble.
   (3) Pasture.*
   (4) Pasture.
   (5) Pasture.*
   (6) Pasture—break in fall.
   (7) Grain—manure stubble and plow under in fall.
   (8) Row crop or specialty seed crop.

*100 lb. 11-48-0 in early spring. Additional nitrogen may be used later in the season.

5. Grain and hay production—no contract crops.
   (1) Grain and alfalfa.
   (2) Hay—100 lbs. 11-48-0.
   (3) Hay—manure in early spring.
   (4) Hay—100 lbs. 11-48-0.
   (5) Grain.

TILLAGE

About two-thirds of all power in farm draft is expended in tillage.

The principle objectives in tillage are:

1. To control weeds and conserve moisture.
2. To improve soil tilth.
3. To develop a desirable soil structure for a seed or root bed.

Other objectives are:

1. To control insects, disease and erosion.
2. To prepare land for irrigation.
3. To incorporate crop residues, fertilizers or soil amendments into the soil.

Some of these objectives conflict and compromises are often necessary in individual situations.

For best results, timeliness, suitable implements, proper adjustment and operation are important. Lack of attention to these requirements can result in wasted effort and actual damage.

There are many types of tillage implements, and the one selected for any particular operation should depend upon field characteristics, vegetation, weather conditions, topography and other factors. (See section on tillage machinery, page 137.)

Summerfallow is designed to control weeds and conserve moisture for the following crop. Therefore begin cultivation early in the spring and keep weed growth to a minimum.

Use a combination of implements and methods that will result in the maximum amount of stubble and trash remaining on the surface of the soil at the time of the next seeding.

A light stubble requires more care to preserve it. Sub-surface implements such as rod and blade weeders should be used. For heavy stubble, discers and one-way discs may be used for the first operations.

Cultivation generally should be on the shallow side; deeper than three to four inches is seldom justified. This depth is usually required to provide adequate weed control.

Fall cultivation of stubble is used to control perennial weeds, germinate annuals, control insects or to reduce an excessively heavy trash cover. It is recommended that the stubble remain standing after cultivation to trap winter snow.

SEEDING

Various types of equipment are available for seeding. See section "Seeding and Planting Equipment" page 138.

In the brown soil zones and wherever a heavy trash cover is essential the high trash clearance hoe drill can be very useful. This implement, with its wide spacings, permits seeding into heavy trash cover without clogging.

Dates of seeding vary considerably within the province depending upon location and season. Consult your nearest District Agriculturist or Experimental Farm.

Wheat and other late maturing crops such as mustard must be sown fairly early. Coarse grains require a shorter growing period. Therefore oats and barley can be sown later which permits pre-seeding tillage. This is a distinct advantage in the control of weeds.

As flax requires a long growing season it should be seeded fairly early. However, since flax is subject to severe damage by spring frosts, seeding should be delayed sufficiently to avoid freezing of the flax seedlings. In Central Alberta flax seeding is usually finished about the 15th of May—seldom later than the 20th for best results.

Rates of seeding will usually be heavier where moisture is more abundant and lighter in the drier soil zones. In tests at the Lacombe Experimental Farm slight reductions in the rate of seeding did not give corresponding reductions in yield. This would indicate that lighter seeding should be considered wherever possible. However, a heavier rate of seeding provides more competition to weeds and is therefore recommended where weed control is a problem. Ranges in seeding rates are as follows:

Name	Bu. per acre
Wheat	¾ - 2
Oats	1½ - 3
Barley	1½ - 2½
Rye	¾ - 1½
Durum	1¾ - 2¼

Name	Pounds per acre
Rape	8 - 10
Flax	30-40
Mustard	3 - 5

Depth of seeding should be kept to a minimum. Sow deep enough to place the seed in moist soil and no more. The use of a packer or press drill will assist in bringing moisture closer to the surface, permitting shallower seeding. The best depth for cereal grains is 1 to 2 inches. Never seed deeper than three inches as reduced yields usually result. Mustard and rape seed should be sown from ½ to 1½ inches deep. Forage seeds should be planted no more than a ½-inch deep for the smallest seeds and 1½ inch for the largest seeds.

USE GOOD SEED

Only by using good seed of suitable variety can a farmer produce most profitably. Pedigreed, high grade seed means varietal purity and uniform results in the field. It also means high germination and freedom from weeds and disease. Low grade seed means reduced yield and quality.

If using your own seed, select the best and obtain a germination test. A representative one pound sample taken to your elevator agent will be sent to a recognized laboratory for testing.

Cleaning is important. This can best be done by a reputable seed cleaning plant. Alberta is well served with good cleaning plants, having some 48 municipal and numerous privately owned plants throughout the province. More are being built each year. In addition to cleaning, the seed should be treated with a recognized seed protectant. The job of testing, cleaning, and treating seed should not be left until spring. It should be done early in the winter when facilities are more readily available.

HARVESTING

Different crops require different methods. The combine has largely replaced the binder-thresher method because of the saving in time and labour. The crop can be straight combined or picked up from a swath. Swathing permits earlier threshing, thereby reducing risk from weather and insects and eliminating green weeds in threshing. See section "Agricultural Engineering", page **139.**

Cereal Crops

Swathing should be started when the grain has a moisture content of 35 to 40 per cent (when the kernel can be dented easily with the thumb nail). The crop should be combined as soon as the grain has dried sufficiently.

The highest moisture content allowed for straight grades and storage is:

Wheat 14.5%, durum wheat 14.8%, oats 14%, barley 14.8%, rye 14%, flax 10.5%.

Malting barley should be in the firm dough stage before swathing and it should be combined as soon as possible. Special attention must be given to combine adjustments. (See section on harvesting machinery, page **139.**)

Forage and Specialty Crops

In harvesting special crops such as grass and legume seed, rape and flax, special attachments and adjustments to the implements will be required. Information on harvesting these crops can be obtained from District Agriculturists or Experimental Farms in your district. (See also section on forage crops, page **57.**)

REFERENCES :

University of Alberta, Edmonton.

Bull. 21—Grey Wooded Soils and Their Management.

Weed Control

Weeds cause the farmer greater losses than any other production hazard. They compete strongly with crops for moisture, food and light. Successful crop production in Alberta depends on moisture conservation and this can only be accomplished by good weed control. Weeds increase production costs and decrease land values.

CLASSIFICATION BY GROWING HABITS

Annuals—grow from seed in the spring or summer, produce seed and die in the same season. (e.g., wild oats, hemp nettle, lamb's quarters.)

Winter annuals—begin growth in the fall, live over winter and produce seed the following year. Stinkweed and some others may grow as either annuals or winter annuals.

Biennials—require two seasons to produce seed. They begin growth in the first year, start from their roots in the following spring, produce seed and die (e.g., goatsbeard).

Perennials—live for more than two years and reproduce from seeds or roots, or both, The roots are dormant over winter and start new top growth every spring (e.g., Canada thistle, couchgrass, leafy spurge).

GENERAL RECOMMENDATIONS FOR THE CONTROL OF ANNUAL, WINTER ANNUAL AND BIENNIAL WEEDS

These weeds can be controlled best by reducing the number of seeds in the soil. Proper tillage, sound planting practices, herbicide use and planned cropping systems will do much to prevent their seeding and re-infesting the soil.

TILLAGE AND SEEDING:

Till before seeding to destroy as many weeds as possible and till only deep enough to kill existing weed growth. Deep tillage at this time is detrimental to the establishment of vigorous seedlings which will compete successfully with weeds.

Sow only sound, well cleaned seed, and place it in firm, moist soil. Seeding with a press drill, or packing, harrowing or rod weeding right after seeding, will hasten germination.

Recommended fertilizers often reduce weed competition by stimulating crop growth. On land heavily infested with weed seeds, sowing 25% more grain will reduce weed competition.

In seasons when weeds have emerged before the crop has sprouts more than one-half inch long, shallow rod weeding or harrowing after seeding will give good weed control.

HERBICIDES:

(See section on Chemical Weed Control.)

SUMMERFALLOW PRACTICES:

(a) Fall tillage is recommended only where there are heavy infestations of winter annuals and biennials resistant to 2,4-D. Some annuals such as wild oats germinate more readily in the spring if lightly tilled late in the fall.

(b) Tillage of fallow in the spring should begin as soon as weed growth warrants, but it should have regard for the control of wind and water erosion. (See soils section.)

(c) Partial fallow, after a crop of hay has been removed, can help to control such weeds as couchgrass and Canada thistle.

COMPETITIVE CROPS:

(a) Barley and rye compete strongly with weeds. Flax is a poor competitor. Barley is useful in a wild oat control program.

(b) The seeding down of forage crops in a more or less regular pattern will help in the fight against weeds.

GENERAL RECOMMENDATIONS FOR THE CONTROL OF PERENNIAL WEEDS

Seeding perennial weeds are controlled like annuals. However, once established, the root system as well as the top growth must be destroyed.

The root system of a perennial plant serves both as a means of spreading and as storage for food. A piece of rootstock containing a bud is capable of initiating a new plant. Extreme caution should be taken to prevent spreading root pieces with tillage machinery.

The roots store the food manufactured by the leaves. The food in the roots is partially used for the new growth from the root buds. If this leaf growth is restricted by repeated or intensive tillage, the roots will eventually die of starvation. Intensive tillage of fallow means tillage operations done often enough to prevent the appearance of green regrowth for more than 4 to 6 days.

Intensive tillage tends to destroy the trash cover rather rapidly and to pulverize the soil. Strip cropping and the use of implements that ridge the soil and do not unduly cut up and bury the trash help to combat erosion. Herbicides may be used as a substitute for part of the tillage in the control of some perennials.

PRECAUTIONS

1. Prevent the spread of weed seeds in the movement of farm machinery, livestock, grain, hay, screenings and soil.

2. Watch for unfamiliar weeds. Specimens, preferably in flower and including part of the root, should be sent for identification to your District Agriculturist or the Field Corps Clinic of the Alberta Department of Agriculture, Edmonton.

3. Community effort is essential to successful weed control. Support your weed inspector or Field Supervisor in his job of controlling weeds.

CHEMICAL WEED CONTROL

Control of Weeds in Field Crops:

Early treatment of the grain crops with selective herbicides such as 2,4-D, MCPA and the butyric compounds 2,4-DB and MCPB under conditions specified in later sections will kill susceptible weeds. The removal of these weeds will usually result in increased crop yield. Young weeds are easier to kill with recommended rates of chemical.

All rates of chemical application are expressed as acid equivalent or active ingredient unless otherwise stated.

Spring Wheat and Barley:

The ester of 2,4-D is the most extensively used herbicide in Alberta for the control of weeds in spring wheat and barley. These grains may be treated safely as soon as the fourth leaf appears or when the plants are about 6 inches high under normal growing conditions. Treatment can be made safely until the early boot stage (shotblade) and again from the soft dough stage to maturity. If weed spraying is necessary before the three-leaf stage, MCPA is preferred.

Oats:

Oats have proved tolerant to MCPA at all stages of growth except from early shotblade to the soft dough stage. This chemical may be applied as soon as weed conditions warrant.

Oats are sensitive to 2,4-D, particularly the ester type, and are frequently damaged by its use. If 2,4-D is used to control weeds resistant to MCPA, use the amine formulation. With 2,4-D amine, treatment should be made between emergence and the two-leaf stage or between the six-leaf and early boot stage.

Flax:

Flax may be treated with 2,4-D or MCPA as soon as the plants are 2 inches high but before there is any sign of bud formation. For maximum safety this crop should be treated early, as soon as there is enough emergence of susceptible weeds to make it practical.

Flax is more tolerant to MCPA than to 2,4-D. MCPA is therefore preferable except for control of more resistant weeds, such as Russian thistle. In such cases 2,4-D ester should be used at the necessary rate in 10 to 12 gals. of water per acre, although delayed maturity and some damage to the flax may occur.

The sodium salt of TCA at 4 to 6 lbs. per acre or dalapon at .75 to 1.25 lb. per acre may be used to control green foxtail in flax. These herbicides may be applied anytime from emergence of the weed until it is 2 inches tall. They may be combined with MCPA or 2,4-D, at the recommended

rates for these herbicides, to control both green foxtail and broad-leaved weeds with the one application.

Winter Wheat and Fall Rye:

Treatments at the rates recommended for annual and winter annual weeds should be applied in the spring as soon as weed growth warrants.

Alfalfa, Red Clover and Alsike Clover:

Newly - seeded stands of these crops should not be treated unless the legume stand is vigorous and dense and weeds are a serious threat.

Alfalfa, red clover or alsike clover (not sweet clover) sown with or without a companion crop of grain can be treated with 2,4-D amine or MCPA amine at 3 to 4 ozs. or MCPA sodium salt at 4 to 6 ozs. per acre. These legumes are safest to treat at the first trifoliate leaf stage. The butyric compounds, MCPB for the clovers and 2,4-DB for alfalfa, can be used at 16 - 20 ozs. per acre in 20 gals. per acre of water.

Early germinating annual weeds, such as Russian pigweed and winter annual weeds can be controlled in established stands of alfalfa seed crops by treating with 2,4-D or MCPA ester at 8 to 16 ozs. per acre before growth starts in the spring.

Sweet Clover:

Sweet clover is susceptible to 2,4-D and MCPA and may be injured by drift of these chemicals. Drift at time of flowering is particularly damaging to seed production.

Peas:

Field and canning peas, when 4 to 8 inches high, may be treated for control of broad-leaved annual weeds with the following:

MCPA sodium salt at 4 to 6 ozs. per acre in as low as 5 gals. of water per acre.

MCPA amine at 3 to 4 ozs. per acre in not less than 15 to 20 gals. of water per acre.

MCPB at 16 to 20 ozs. per acre in 20 gals. per acre of water.

Grasses:

(Brome, Crested Wheat, Creeping Red Fescue and Kentucky Bluegrass.) New seedings of grass may be treated with up to 8 ozs. of 2,4-D ester per acre after the three-leaf stage has been reached. Established grass stands can tolerate heavier dosages, the rate needed depending on the weed species. Seed yield of grasses may be reduced by the use of 2,4-D just before and at flowering.

Sweet clover can be removed from grass stands with 8 ozs. per acre of 2,4-D ester when the legume is about 8 inches tall.

Lawns:

Susceptible weeds in new lawns may be sprayed with 2,4-D or mixtures of 2,4-D and 2,4,5-T once the grass plants have developed three leaves. Established lawns may be sprayed whenever weeds are showing vigorous growth, preferably in late May. Couchgrass control is impractical in established lawns.

To control dandelions and most broad-leaved weeds in established lawns use 2,4-D amine at 16 ozs. per acre. For each 1,000 square feet of lawn, this rate works out to 1½ tablespoons of chemical containing 80 ozs. of acid equivalent per gal. or 2 tablespoons of chemical containing 64 ozs. acid equivalent per gal. Injury to bent grasses may result from the above treatment. Some damage may be done to white Dutch clover by 2,4-D but it usually recovers completely. White Dutch clover and chickweed may be killed with mecoprop and silvex in established lawns.

Care must be taken to prevent the chemical drift from reaching susceptible plants. Use a watering can or a knapsack sprayer at low pressure to provide a coarse spray.

Pasture and Range:

Selective chemicals may be used for weed and brush control on native grass pastures, waste land or cultivated pastures that do not contain legumes. Treatment with 2,4-D ester at 1 to 2 lbs. per acre is recommended. For rosebush use a mixture of 2,4-D and 2,4,5-T. More than one application may be necessary. (See also control of woody plants.)

Uncultivated Lands, Fencelines and Barnyards:

Soil sterilants may be used to remove all growth, to prevent the spread of a troublesome weed, or to create a clean area for implement storage. Such chemicals as chlorate and borate-chlorate compounds at 3 to 4 lbs. of product, or atrazine or monuron at 2 to 3 ozs. per 100 square feet will effectively denude small areas of vegetation. These compounds should not be used near trees, nor should they be allowed to seep into water intended for domestic or irrigation uses.

Rates of Chemicals for Crops:

The quantity of active ingredient to use within the ranges recommended in the table below will be influenced by (1) stage of weed growth, (2) kind of weed, and (3) growing conditions. Annual and biennial plants are most susceptible when young. Established perennials are generally less susceptible than annual weeds, with best results being obtained if the chemical is applied at the early bud stage. The wide variation in the susceptibility of weeds to chemicals is reflected in the Weed Classification table. Weeds are more susceptible to 2,4-D and MCPA under conditions of rapid growth.

The higher rates in each group are recommended during advanced growth stages of weeds, under drier conditions, and when

crops are heavily infested with weeds. The rates shown in brackets in the table may cause injury to the crop, but this will frequently be less serious than the losses caused by weeds if untreated.

RATES OF APPLYING CHEMICALS

This table gives the recommended rates of applying 2,4-D and MCPA in water spray for the control of weeds in growing crops.

Note:— Most fields contain a mixture of weeds. Use rates that will control the most resistant weeds, within crop tolerance limits.

Crop	Formulation	Ounces Acid Equivalent Per Acre				
		Weed Group I	Weed Group II	Weed Group III	Weed Group IV	Weed Group V
	2,4-D					
Wheat, Barley	Ester	3 to 4	4 to 6	6 to 8	(9 to 12)	(12 to 16)
Rye and Corn	Amine	4 to 5	5 to 7	7 to 9	(10 to 14)	(15 to 20)
*Oats	Amine	4 to 5	5 to 7	(7 to 9)		
*Flax	Ester	3 to 4	(4 to 6)	(6 to 8)		
	Amine	4 to 5	(5 to 7)	(7 to 9)		
	MCPA					
Oats (Wheat,	Ester	3 to 4	4 to 6	6 to 8	(9 to 12)	(12 to 16)
Barley, Rye	Amine	4 to 5	5 to 7	7 to 9	(10 to 14)	(15 to 20)
and Corn)	Sodium Salt	5 to 6	6 to 8	8 to 10	(11 to 15)	(15 to 20)
	Ester	3 to 4	4 to 6	(6 to 8)	(9 to 12)	
Flax	Amine	4 to 5	5 to 7	(7 to 9)	(10 to 14)	
	Sodium Salt	5 to 6	6 to 8	(8 to 10)	(12 to 15)	
Alfalfa, red &	Amine	3 to 4 in 15 to 20 gals. water per acre				
Alsike Clover	Sodium					
and Peas	Salt	4 to 6				

* For emergency use only. Considerable reduction in crop yield can be expected particularly where the heavier rates (in brackets) are used.

Where the above chemicals are applied in a dust carrier, it is generally advisable to use up to 1/3 more acid per acre than the rate recommended in a water spray. (See Farm Machinery section for spraying and dusting equipment.)

WEED CLASSIFICATION ACCORDING TO RESPONSE TO 2,4-D and MCPA

GROUP I — Very Susceptible
Wild Mustard

GROUP II — Susceptible annuals (require higher dosages than Group I).

Ball Mustard	Lamb's quarters	Common ragweed
Stinkweed	False ragweed	Sunflowers (Gr. III for MCPA)
Great ragweed	Tumbling mustard	Hare's ear mustard
Wormseed mustard	Indian mustard	

GROUP III — Moderately susceptible (Susceptible in early growth stages. May become less susceptible under adverse conditions and/or advancing growth).

Blue Bur	Stinging nettle	Gumweed
Burdocks	Goatsbeard	Cocklebur
Shepherd's purse	Common plantain	Sweet clover (Gr IV for MCPA)
Dandelion (in lawns)	Russian pigweed	Prickly lettuce
	Wild radish	

GROUP IV — Moderately resistant (Under adverse conditions and/or with advancing growth become resistant). Perennials require retreatment.

Prostrate amaranth	Quickweed	Alfalfa
Pepper grass	Biennial wormwood	Perennial sowthistle (Group V for MCPA)
Blue lettuce	Prairie thistle	Common chickweed
Canada thistle	Purslane	Russian thistle (Gr. V for MCPA)
Red root pigweed	Common groundsel	Dandelion (in fields)
Curled dock	Spear-leaved goosefoot	Field bindweed
Dog mustard	Smartweeds	Tartary buckwheat
Tall buttercup	Hedge bindweed	Pineapple weed
Hoary Cress	Wild buckwheat	
	Annual sowthistle	

GROUP V — Consists mainly of perennial weeds of which generally only the top growth is controlled with 2,4-D or MCPA.

Field horsetail (Gr. IV for MCPA)	Scentless mayweed (Resist to MCPA)	Hemp nettle (Gr. IV for MCPA)
Russian knapweed	Leafy spurge	Creeping buttercup (Gr. IV for MCPA)

GROUP RESISTANT TO 2,4-D and MCPA (Control impossible or impractical with these chemicals).

Bracken	Bladder campion	Tansy
Cow cockle	Night flowering catchfly	Poverty weed
Grasses	Ox-eye daisy	Purple cockle
Shrubby cinquefoil	Knotweed	Pasture sage
Stinking mayweed	White cockle	Milkweed
Yarrow	Cacti	Shield cress
Wild liquorice	Toadflax	Corn spurry

— CONTROL OF SPECIFIC WEEDS — ANNUALS

Wild Oats:

Cultural methods afford efficient and effective control but are very dependent on the weather and the use of early maturing crops. These limitations can be largely overcome by the use of one of the recently developed herbicides, Avadex or Carbyne.

Delayed seeding is the best method for controlling wild oats. The surface should be tilled to a depth of not more than four inches early in the spring to promote germination. Seeding should be delayed until after maximum emergence of wild oats has occurred.

In most localities seeding can be delayed until the first week in June if necessary. Pre-seeding tillage to kill wild oats is best done in dry, hot weather, and should not go below 4 inches, otherwise fresh wild oat seed will be brought up to further infest the crop. If the soil is moist, seed as shallow as possible. An early maturing barley is the most suitable crop and should be seeded at a slightly heavier rate and a little deeper than is normal. Fertilizer will help to ensure best results.

Flax should not be seeded on wild-oat-infested land, unless it is planned to use an berbicide.

Post-seeding Cultivation

Rod weeders, cable weeders or harrows can be used to advantage to destroy wild oat plants after the crop has been seeded. Seeding should be done a little deeper than normal. Begin cultivation when the sprout on the grain crop is one-half inch long. To be effective, the surface soil must be dry and relatively free of trash and the weather bright and warm.

Fall Cultivation

Shallow tillage of stubble to cover wild oat seeds is a good practice in heavily infested fields. The cultivation should be done after the new seeds have had an opportunity to dry — usually in late September or early October. This tillage will provide a seedbed for the wild oats and promote rapid germination in the spring. The machine used will differ with the various soil types.

Cropping Methods

(a) GREEN FEED crops, such as oats, for forage, cut prior to heading of wild oats afford a good meause of control. Wild oats if headed when cut will mature in the sheaf and seeds will be spread in feeding. (b) FALL SEEDED crops such as fall rye can be used to advantage in conjunction with crops of green feed and late seeded early maturing barley in a cleaning up rotation.

(c) FORAGE CROPS — Grasses and legumes left down for some years will do much to lessen the incidence of wild oats.

Chemical Control of Wild Oats

Avadex is recommended as a **pre-planting** application with flax, canning peas, sugar beets, rapeseed, mustard and sunflowers, at rates of 1½ to 2 lb. per acre. The herbicide should be applied in 5 gallons per acre or more water at 30 psi and incorporated the same day to a depth of not more than 3 inches, preferably with a disc type implement. Seeding of the crop may be done immediately or as soon as convenient. The higher rate will give increased control with no injury to these crops.

Avadex is recommended as a **post-seeding** application to fields seeded to **barley** at rates of 1¼ to 1½ lb. per acre. Seeding the crop to a depth of 3 inches and subsequent incorporation to a depth of 2 inches will minimize crop damage. The herbicide should be applied in 5 gallons per acre or more of water at 30 psi. For best results spraying and incorporating should follow directly after seeding. Under very moist conditions these operations may be delayed as long as three days. Under conditions where the surface soil is extremely dry to the depth of incorporation poor control may result.

Carbyne is recommended as a **post emergence** application to wheat, barley, flax, canning peas, mustard, rapeseed, sugar beets and sunflowers, at rate of **4 to 6 oz. per acre** in 5 gallons per acre of water at a pressure of 45 psi. The chemical must be applied when the majority of the wild oats are in the 2-leaf stage. The 4 oz. rate is recommended only for light to moderate infestations (up to 150 wild oat plants per square yard) which reach the 2-leaf stage in not more than 11 days after emergence (good growing conditions). The higher rates should be used on heavy infestations where coverage is difficult due to shading or under adverse growing conditions such as extended low temperatures near or below freezing, lack of moisture, excessive wind or heat. Injury is likely to occur if flax is sprayed at 6 oz. per acre during the cotyledonary stage or after the 14-leaf stage has been reached.

The chemical acts by killing or stunting the wild oat plant and thereby preventing or reducing competition within the crop. The effect is gradual and may not be evident for 2 to 3 weeks after spraying. The degree of control is largely dependent upon the uniformity of emergence of the wild oats.

Wild Buckwheat

Infestations can be reduced by good cultural practices. Delay seeding until the early-emerged wild buckwheat has been destroyed by tillage. Harrowing or rod weeding after seeding will give further control.

Chemicals can be used to control or suppress wild buckwheat in growing cereal crops. Best results are obtained from two applications of 2, 4-D ester at 5 oz. per acre each. The first application should be made not later than the second true-leaf stage of the buckwheat with the second one week later. If, at this stage, the grain is too small for safe treatment with 2, 4-D, use MCPA ester. In oats use MCPA ester at 5 oz. per acre for both treatments. A single treatment at the highest recommended rate for the crop being sprayed will give a fair measure of control. In grain crops undersown with alfalfa 2,4-DB ester at 20 to 24 oz. per acre in 15-20 gals. of water per acre can be used to give partial control.

Tartary Buckwheat

Tillage and cropping practices used for other annual weeds apply also to tartary buckwheat. For chemical control in wheat and barley, treat with 6 to 8 oz. of 2,4-D ester per acre as soon as crop growth permits. Low volatile 2,4-D esters give better control but at a greater cost. MCPA at 12 to 16 oz. per acre is better for oats and flax or for very early spraying of wheat and barley. Best control results from treatment not later than the first or second true-leaf stage of the weed. These treatments will reduce growth and seed set but may not kill all of the weeds present.

In grain crops undersown with alfalfa 2,4-DB ester at 20 to 24 oz. per acre may be used to give some degree of control.

PERENNIALS

Couchgrass (quackgrass, twitchgrass)

Cultivation is the only practical method of controlling large scale infestations of couch grass. Thorough tillage such as reasonably deep plowing or one-way discing just before freeze-up is recommended. In the following year as soon as the grass has resumed growth, cultivation should be continued and repeated throughout the summer months whenever re-growth becomes noticeable. A disc implement should be used to shred the root stocks and starve the plants. If the soil becomes dry and the underground parts become dormant, a cultivator equipped with chisel points followed by a cable or rod weeder should be used to bring the rhizomes to the surface to dry out. Working with a disc implement should be resumed if the soil again becomes moist enough to cause growth of the plants. Care must be taken not to drag pieces of rhizomes to clean parts of the field. During seasons of heavy rainfall which restrict cultivation mowing or grazing to prevent heading is desirable. Heavy pasturing prior

to initiating cultivation will facilitate eradication.

On small patches TCA and dalapon can be used as "short term" soil sterilants. On undisturbed sod 3 to 4 oz. of TCA or about one-half this quantity of dalapon per 100 sq. ft. is usuallysufficient for seasonal control. A lower rate of TCA, 2 to 2½ oz. per 100 sq. ft., can be used if the sod is tilled or plowed before and/or after application. Dalapon usually works best when applied to the leaves and followed by cultivation after the foilage turns brown. Follow-up cultivations may be necessary for complete kill with either TCA or dalapon. In drier areas the effect of the chemical may extend into the next growing season. This is more likely to happen with TCA than with dalapon.

Sodium chlorate compounds at 2 to 3 lb. per 100 sq. ft. of product will eradicate couchgrass, but the soil may remain sterile for two or more years. The chemical should be applied in the dry form to reduce the fire hazard when pure sodium chlorate is used.

Atrazine or monuron may be used on non-crop land. Both are long term soil sterilants. Rates of 1 to 2 oz. per 100 sq. ft. should be applied and the soil should not be disturbed for a year. They are safe to handle but should not be used near desirable trees.

Canada Thistle and Perennial Sowthistle

Near-complete to complete eradication can be achieved by a full season of intensive tillage, beginning immediately after harvest and continuing until freeze-up of the following year.

The tillage operations may be discontinued in mid-June and the thistles treated with the ester of 2,4-D at not less than 16 oz. per acre when in the late bud stage. Tillage should recommence as soon as regrowth appears and continue until freeze-up. The top growth of these weeds can usually be killed and seed formation prevented in grain crops by the use of 2,4-D at the maximum recommended rate for the crop concerned. MCPA may also be used for Canada thistle but is less effective against perennial sowthistle.

Infested areas may be seeded to a suitable and strongly competitive grass. Treating with 2,4-D when the grass has attained the three-leaf stage of growth will weaken the thistles and allow the grass to become established. Annual treatment with 2,4-D throughout the life of the grass stand will reduce the thistle stands. This procedure is best suited to slough edges, roadsides, and other uncultivated areas. The butyric herbicides at 20-24 oz. per acre can be used for the control of these perennial thistles; use MCPB in flax, peas, and seedling clovers, except sweet clover, and 2,4-DB in seedling alfalfa.

On non-crop land repeat dosages of the ester of 2,4-D at 16 oz. per acre will control, if not eradicate, these weeds. Best results are obtained if treatments are made when thistles are in bud to first bloom. Soil sterilants such as sodium chlorate or chlorate-borate compounds at 3 lb. of product per 100 sq. ft., atrazine or monuron at 2 oz. per 100 sq. ft. will kill these weeds, but their use is practical only in small patches. Treatment should be made for a distance of not less than 6 feet beyond the limits of the patch.

Field Horsetail

The top growth of this weed can be effectively suppressed by 4 oz. per acre of the ester of MCPA applied when it is completely emerged. At this time the cereal crop will be at an advanced growth stage, and spraying should be done either at early shot blade or at a post-flower stage. 2,4-D can be used in place of MCPA but there is more chance of injury to the cereal crop.

The annual use of MCPA for top-growth kill of horsetail in cereals will reduce the stand of the weed.

Toadflax, Leafy Spurge, Hoary Cress, Field Bindweed, Russian Knapweed, and Bladder Campion

On crop land, intensive tillage of fallow will reduce the stand of these weeds sufficiently to permit successful crop production the following year. Eradication by continued intensive tillage is possible, but must be continued into the third season. Because of the danger of erosion, cultural methods should be confined to limited areas of relatively narrow strips.

Grass may be seeded on infested areas after a season of intensive cultivation. Yearly spraying with the ester of 2,4-D at 24 to 32 oz. per acre will reduce the stand and vigour of these weeds. Such seeding and treating procedure is recommended for poorer crop lands.

Small patches can be controlled by the use of the same soil sterilants mentioned above for thistles, using 1½ times the rates suggested for thistles. Areas treated with soil sterilants should not be cultivated for at least one year and retreatment should be given if regrowth appears. If seedlings appear they may be tilled or treated with ester at 24 oz. per acre 2,4-D.

Some other herbicides are useful for the control of specific weeds. For example, 2,4-D at 5 to 8 lb. or amitrole at 4 to 6 lb. per acre can be used for hoary cress; 2,3,6-TBA at 15 to 20 lb. per acre for toad flax, leafy spurge, field bindweed and Russian knapweed; and 2,4-D-borate mixture at 1.5

to 2 lb. of product per 100 sq. ft. for toadflax and leafy spurge. The last mentioned herbicide can be used when toadflax and leafy spurge are to be controlled in grassed areas.

Top growth of leafy spurge, hoary cress, and field bindweed can be controlled in grain crops with the ester of 2,4-D at 6 to 8 oz. per acre.

CONTROL OF BRUSH AND TREES

Brush killing mixtures are generally a combination of 2,4-D and 2,4,5-T. Where all the species to be controlled are susceptible to 2,4-D (see woody plants classification) this chemical is recommended by itself since it is cheaper than 2,4,5-T. Often it is necessary to make at least two treatments. Where mixtures are used the most efficient ratio is usually 2 parts 2,4-D to one part 2,4,5-T. Commercially prepared brushkillers usually contain one part of 2,4-D to one part of 2,4,5-T.

There are three main methods of killing brush and trees with chemical.

Foliage Spraying — Spray as soon as the leaves are fully expanded. Use 2,4-D ester, 2,4,5-T, or mixtures of the two, depending on the species present. Wet all foliage thoroughly using 2 to 4 lb. of total acid equivalent in 10 or more gal. of water per acre. Close stands of tall poplars on pasture lands usually cannot be killed by one spraying, therefore a mechanical clearing operation followed by spraying of the regrowth is recommended.

Over-all Dormant Spraying — This is done during the absence of foliage. A mixture of 2,4-D and 2,4,5-T should be used. Two to 4 pounds of the mixture should be applied in 10 to 15 gal. of diesel fuel per acre.

Basal Bark and Stump Treatment — For basal bark treatment apply the chemical from a height of 2 feet down to the ground line. For stump treatment cover the entire stump. In each case the bark at the ground line and the protruding roots should be wetted until the liquid begins to run off. A solution of 1½ lb. of total acid of 2,4-D ester or mixtures of 2,4-D and 2,4,5-T in 10 gal. of diesel oil is recommended.

Classification of Woody Plants According to Their Response to Herbicides

Group 1—Susceptible to 2,4-D

Caragana	Lilac	Saskatoon
Chokecherry	Manitoba Maple	Snowberry
Currants	Pincherry	Spirea
Hazelnut	Poplar, Aspen	Willows
Honeysuckle	Poplar, Balsam	Wolf Willow

Group 2—Resistant to 2,4-D

Shrubby Cinquefoil	Raspberry
Oak	Rose

Group 3—Apparently more susceptible to 2,4,5-T than to 2,4-D

Ash	Bearberry	Dogwood
Hawthorn	Raspberry	Rose
Poison Ivy	Caragana	

PRECAUTIONARY MEASURES WHEN USING HERBICIDES

1. The chemicals 2,4-D and MCPA are non-poisonous and non-flammable. They are no more corrosive to metal and rubber than water. Excessive breathing of the fumes may cause nausea to some operators.

2. Whenever systemic herbicides such as 2,4-D, 2,4,5-T, and MCPA are used there is danger of spray, dust, or vapour drift. Therefore, when such herbicides are used in the vicinity of susceptible crops, gardens, and shrub or tree plantations, suitable precautions should be taken to prevent drift, and the salt forms (sodium or amine) or the low volatile esters should be used.

3. After storage shake or stir 2,4-D thoroughly before using. Large drums of the chemical may be mixed with a gasoline toggle pump.

4. When applied in excessive quantities, 2,4-D and MCPA will kill a very wide range of plants. Warning is therefore given not to apply rates higher than the maximum recommended for the respective crops and weeds, and to be sure that spraying and dusting machines spread the chemicals uniformly.

5. It is recommended that receptacles, containers, machines, and handgun hose, used for applying systemic herbicides, should not be used for the application of

fungicides and insecticides to susceptible crops. If they must be used, thorough cleaning is necessary. Rinse with water containing a small amount of detergent and fill with a weak solution of household ammonia (1 cup of ammonia to each 3 gal. of water). Run some solution through the sprayer, allow to stand overnight, drain, and rinse thoroughly with water. Hand-gun hoses should never be used to transfer drinking water.

6. Sodium chlorate is flammable but can be used to advantage if proper precautions are taken. Some commercial preparations of sodium chlorate contain fire-retardant materials and therefore are safer to use.

7. Care should be taken not to place herbicides, especially soil sterilant compounds, in the feeding zone of desirable trees.

8. Do not use herbicides where they may contaminate water used for irrigation or drinking purposes.

9. Do not store systemic herbicides close to seeds, fertilizer, insecticides, or fungicides because of the danger of contamination by leaked or spilled herbicide or by its vapors.

REMEMBER! Chemicals are Made to Kill Plants — Make sure that they Kill Only Undesirable Plants.

Cereal and Oilseed Crops

In recent years wheat, oats, barley, flax, and rye have occupied an average of slightly over 12 million acres per year, with an average annual production valued at over 300 million dollars based on commercial prices. Since much of Alberta grain is marketed through livestock, the actual return is considerably greater. These figures indicate that the production of grain crops continues to be Alberta's most important agricultural enterprise.

New grain varieties are being developed continually. In Alberta the responsibility for improvement rests with the plant breeders of the Department of Genetics, University of Alberta, Edmonton, and the Canada Department of Agriculture at Lethbridge, Lacombe, and Beaverlodge. Superior new varieties may be made available through introduction from other countries, through selection within established varieties, or through regular plant breeding programs. No matter what the origin of a promising new variety may be, it must be tested extensively and intensively for several years before it is released to the farmers of Alberta.

Examples of new varieties still under seed increase and tests are Cypress, a sawfly resistant hard red spring wheat of good milling and baking quality, and Park, an early maturing hard red spring wheat adapted to the central and northern areas.

The Alberta Varietal Zonation Committee is composed of representatives from the Department of Genetics, University of Alberta; Field Crops Branch, Alberta Department of Agriculture; and the Research Branch and Production and Marketing Branch of the Canada Department of Agriculture. The purpose of this committee is to co-ordinate the findings of the various experimental agencies to determine the suitability of grain crop varieties for production in different areas of Alberta. Suitability of crops and varieties depends primarily upon growth conditions and the province has been divided into zones in which these conditions are relatively uniform. Such zones naturally merge into each other and the boundaries as shown on the map indicate only general outlines. Moreover, within any zone local conditions in small areas or special circumstances may make it profitable to grow a variety or crop which is not recommended for the zone as a whole. Usually more than one variety of each crop is recommended in a zone because of varied cropping and management practices.

The committee bases its recommendations upon findings obtained by the various experimental agencies. Results come mainly from comparative trials (totalling approximately 150 per year) conducted at well distributed locations in every zone. The committee meets annually to review results and revise recommendations. Established varieties are from time to time superseded by others that possess more desirable features.

Varietal recommendations for the current year become available about the middle of January each year. The publication entitled "Varieties of Grain for Alberta", is widely distributed through grain and seed trade channels. Copies may also be obtained from District Agriculturists, Experimental Farms, Alberta Field Crops Branch, Plant Products Division, and the Department of Genetics, University of Alberta.


FORT VERMILION
4C
HINES CREEK
PEACE RIVER
4A
3C
SPIRIT RIVER
4A
4B
4B
3C
HIGH PRAIRIE
GRANDE PRAIRIE
ZONE 4
SANGUDO
WESTLOCK
BONNYVILLE
3B
EDSON
EDMONTON
3B
4A
VERMILION
LLOYDMINSTER
3A
4A
BRETON
CAMROSE
2D
WETASKIWIN
ZONE 3
ROCKY MOUNTAIN HOUSE
3B
RED DEER
STETTLER
2B
PROVOST
CORONATION
OLDS
THREE HILLS
HANNA
ZONE 2
CALGARY
BASSANO
3A
HIGH RIVER
ZONE 1
2C
2A
MEDICINE HAT
LETHBRIDGE
2C
PINCHER CREEK
CARDSTON
MILK RIVER
MAP of ALBERTA
showing
SOIL CLIMATIC ZONES

VARIETIES RECOMMENDED FOR 1962**

(Varieties are listed in alphabetical order, not according to merit or desirability)

Zones	Spring Wheat	Barley	Oats	Flax
1	Canthatch *Chinook *Rescue Thatcher	Compana Palliser	Eagle Exeter	Redwood
2A	Canthatch *Chinook *Rescue Thatcher	Compana Palliser	Eagle Exeter	Redwood
2B	Canthatch *Chinook Lake *Rescue Thatcher	Husky Parkland	Eagle Rodney	Redwood
2C	Canthatch *Chinook *Rescue Thatcher	Betzes Husky Parkland Wolfe	Eagle Garry Rodney	Redwing Redwood
2D	Canthatch Selkirk Thatcher	Gateway Husky Parkland	Eagle Garry Rodney	Redwing Redwood
Irrigated Areas	Canthatch Selkirk Thatcher	Betzes Jubilee Keystone	Eagle Rodney	Redwood
3A	Canthatch Saunders Thatcher	Gateway Husky Parkland Wolfe	Eagle Garry Glen Rodney	Redwing Redwood
3B	Canthatch Saunders Thatcher	Gateway Husky Wolfe	Eagle Garry Glen Rodney	Redwing Redwood
3C	Canthatch Saunders Thatcher	Gateway Husky Olli Parkland	Abegweit Glen Victory	Marine Redwing
4A	Canthatch Saunders Thatcher	Gateway Olli Parkland	Eagle Garry Glen Larain	Redwing
4B	Canthatch Saunders Thatcher	Gateway Husky Olli Parkland	Abegweit Glen Victory	Marine Redwing
4C	Canthatch Saunders Thatcher	Gateway Parkland Wolfe	Abegweit Glen Victory	Marine Redwing Sheyenne

* Sawfly resistant—see description.

** Revised annually in "Varieties of Grain for Alberta, Publication No. 91."

HARD RED SPRING WHEAT

THATCHER is a high yielding variety of wide adaptability. It is resistant to lodging and highly resistant to shattering. The kernels are small, have a tendency to bleach and may be low in bushel weight under dry conditions. Thatcher is resistant to most races of stem rust (except 15B), but is susceptible to leaf rust and bunt.

CANTHATCH is similar to Thatcher in all respects except for its superior resistance to stem rust.

LAKE compared with Thatcher is later in maturity, has longer straw, is equal in lodging resistance and has larger kernels which show less tendency to bleach. Because of its late maturity it is recommended only in Zone 2B. It is resistant to bunt and to most races of stem rust (except 15B), but is susceptible to leaf rust.

SAUNDERS is earlier maturing than Thatcher, and is generally slightly lower yielding except in the Peace River area. It is equally resistant to lodging and does not shatter readily. Saunders is resistant to most races of stem rust (except 15B), moderately resistant to bunt, but is susceptible to leaf rust.

SELKIRK is slightly earlier than Thatcher and compares favourably in yield and lodging resistance, but has a larger, less attractive kernel. It is resistant to stem rust (including Race 15B) and bunt, and moderately resistant to leaf rust.

CHINOOK and RESCUE are similar to Thatcher in maturity, less resistant to shattering and lodging and lower yielding. Both are resistant to the wheat stem sawfly and most races of stem rust (except 15B), but are suceptible to bunt and leaf rust. CHINOOK produces attractive grain of high bushel weight. RESCUE is slightly more sawfly resistant than Chinook but is not eligible for grades higher than No. 3 Northern.

MARQUIS, though used as the standard for milling and baking quality, is no longer recommended because of its late maturity, susceptibility to diseases, and lower yielding ability.

RED BOBS is similar to Thatcher in maturity and yield but shatters more readily. Because of its lower quality it is not eligible for grades higher than No. 3 Northern and is no longer recommended for production.

GARNET is slightly earlier than Saunders and contrary to general belief will not exceed Saunders in yield. Because of poor milling and baking qualities it is marketed under special grades and is no longer listed as a recommended variety.

PEMBINA is earlier than Thatcher but is low yielding and its superior rust resistance is of little value in Alberta.

DURUM WHEAT

The production of DURUM (macaroni) wheat varieties should be restricted to southern zones because of their late maturity. They are similar to hard red spring wheats in yields, but are generally more susceptible to lodging. MINDUM, RAMSEY, and STEWART are suitable varieties for production in southern Alberta.

HARD RED WINTER WHEAT

KHARKOV M.C. 22 is the most winter hardy variety available. It is high yielding, resistant to lodging but tends to shatter and is very susceptible to bunt. YOGO is equal to Kharkov in yield, more resistant to bunt and to shattering, but less resistant to lodging. WINALTA is a winter hardy, high yielding, early maturing variety with superiority over Kharkov and Yogo in milling and baking quality. It is highly resistant to shattering. These varieties are suitable for production in Zones 1, 2A, 2C, and 3A.

JONES FIFE (Silver Chaff) is less winter hardy and of much poorer quality than the recommended varieties.

SOFT WHITE SPRING WHEAT

This crop should be grown only under contract with a milling company. The most suitable varieties presently available are KENHI and LEMHI 53. KENHI is resistant to stem rust including race 15B and moderately resistant to leaf rust. LEMHI 53 is moderately resistant to most races of stem rust (except 15B), and susceptible to leaf rust. Both are late maturing varieties.

OATS

EAGLE is a high yielding variety with wide adaptability. It is semi-resistant to lodging, late maturing, and has a comparatively small kernel. Eagle is resistant to smut, moderately resistant to crown rust but susceptible to stem rust.

VICTORY is recommended for production in northern regions, where it is equal to Eagle in yield and maturity. It has a more attractive grain, produces longer straw, and is less resistant to lodging than Eagle. Victory is susceptible to smut, stem and crown rust.

ABEGWEIT, recommended in northern regions, is similar to Victory in yield, earlier maturing and more resistant to lodging, but has a less attractive grain. It is resistant to some races of stem and crown rust and moderately susceptible to smut.

RODNEY yields slightly less and matures slightly earlier than Eagle and is similar in lodging resistance. It has a large, plump kernel that hulls readily. Rodney is resistant to smut and most races of stem and crown rust.

GARRY is slightly earlier maturing than Rodney and slightly lower yielding, but similar in lodging resistance. It is resistant to smut, stem rust, and most races of crown rust.

GLEN is slightly earlier maturing and higher yielding than Garry. It is equal to Garry in lodging resistance but has less attractive kernels. Glen is resistant to grey speck disease (caused by manganese deficiency) and semi-resistant to covered smut, susceptible to loose smut, moderately resistant to crown and stem rust.

LARAIN is a very early maturing variety with large, plump kernels. It is resist-

ant to lodging, but is low yielding and should be grown only where very early maturity is essential. It is susceptible to smut, stem and crown rust.

EXETER is recommended for production in Zones 1 and 2A where it is similar to Eagle in yield. It is a large-seeded tall variety with somewhat less lodging resistance than Eagle. Exeter is semi-resistant to smut, resistant to many races of stem rust but susceptible to crown rust.

FUNDY is slightly earlier maturing but lower yielding than Glen. It is not recommended.

BARLEY

OLLI, eligible for C.W. grades and acceptable to the malting trade, is a very early maturing, rough-awned, low yielding variety which is susceptible to lodging and shattering. It has considerable resistance to loose smut but is susceptible to stem rust and leaf diseases.

GATEWAY, eligible for C.W. grades, is smooth-awned, higher yielding, and slightly later maturing than Olli. It is more resistant to lodging and shattering and is susceptible to loose smut, stem rust and leaf diseases.

PARKLAND, eligible for C.W. grades and acceptable to the malting trade, is considerably higher yielding but much later maturing than Olli. It is smooth-awned and moderately resistant to lodging and shattering. Parkland is resistant to stem rust, susceptible to loose smut and leaf diseases.

COMPANA, eligible for 3 C.W. 2-row grade, is an early, two-rowed, semi-smooth-awned variety, which yields well in dry areas and is suitable for straight combining. Under moist conditions it lodges badly. Compana is susceptible to stem rust, loose smut, and leaf diseases.

HUSKY, not eligible for the C.W. grades, is a smooth-awned, late maturing, very high yielding variety that is resistant to lodging. It tends to shatter in southern regions but is satisfactory in this respect in zones where it is recommended. Husky is resistant to stem rust but susceptible to loose smut and leaf diseases.

JUBILEE, not eligible for the C.W. grades, is similar to Husky in all respects except that it is later maturing and higher yielding.

KEYSTONE, not eligible for the C.W. grades, is a smooth-awned variety somewhat lower in yield but more resistant to lodging than Husky, and yields well under irrigation. It is resistant to all races of loose smut and moderately resistant to most of the common leaf diseases.

WOLFE, not eligible for C.W. grades, is a smooth-awned variety that matures 4 or 5 days later than Olli. It is highly resistant to lodging and higher yielding than Olli in central Alberta. It is susceptible to rust, loose smut, and leaf diseases.

PALLISER, eligible for 3 C.W. 2-row grade, is a semi-smooth-awned variety similar to Compana in seed type, disease reaction and most other characteristics. It is taller than Compana, later in maturity, and more resistant to lodging and post-maturity stem break.

BETZES, eligible for C.W. 2-row grades, is a rough-awned variety of medium maturity. It is similar in seed type to Hannchen, but is shorter, more resistant to lodging and post-maturity stem break and is higher in yield. It is susceptible to shattering in southern regions.

O.A.C.21 was once the most popular malting variety in Canada. Though still the standard of quality for all malting varieties it has been replaced largely by Montcalm and more recently by Parkland.

MONTCALM, formerly recommended in Zones 2, 3, and 4, was replaced by Parkland since the latter is slightly earlier, more resistant to lodging, and higher yielding.

FLAX

MARINE is early maturing and resistant to lodging, wilt, and rust. In the absence of rust it yields less than Redwing.

REDWING is very early maturing, good yielding, resistant to lodging, moderately resistant to wilt, but susceptible to rust.

REDWOOD is late maturing, high yielding, moderately resistant to lodging, and resistant to wilt and rust.

SHEYENNE is very early maturing and resistant to lodging, rust, and wilt. In the absence of rust it yields less than Redwing.

RAJA is early maturing and responds well to late seeding. However, when sown at the proper time it does not equal Redwood in the south or Redwing in the north.

CREE, licensed in 1961, is similar to Redwood under Alberta conditions and is being tested extensively.

RYE

ANTELOPE, DAKOLD, PETKUS, and SANGASTE are varieties of fall rye suitable for Alberta. Antelope and Dakold are more winter hardy than Sangaste which in turn is slightly hardier than Petkus. Sangaste and Petkus have large seeds while Antelope and Dakold have small seeds. Petkus has out-yielded all varieties in south and south central Alberta, while Sangaste has given superior yields in the Edmonton area. Prolific is a suitable variety of spring rye.

RAPESEED

There are two types of rapeseed being grown in Alberta. Argentine rape which requires from 120 to 130 days to mature is much higher yielding than Polish rape which ripens some three weeks earlier. Ar-

gentine rape shatters more readily when ripe. GOLDEN and NUGGET are good yielding varieties of the Argentine type and ARLO is a good yielding variety of the Polish type.

MUSTARD and SUNFLOWER

It is advisable that these crops be grown under contract. Mustard production should be restricted to the extreme southern part of the province. Sunflower production should be limited to that area south and east of a line through Brooks, Strathmore, and Claresholm.

IMPORTANT SEED FACTS

Use good seed. — Any elevator agent and most of the seed companies will accept your order for registered or certified seed. The use of good seed of recommended variety is the first step in production of good, high quality crops. Pedigree seed (registered or certified) assures the grower that he is getting the best available seed, free from impurities, and of high viability. It is recommended that all farmers use pedigree seed, at least at frequent intervals.

Germination test — Frost and other conditions may lower the percentage of germination and also the vitality of seedlings. Even though the grain looks quite normal and healthy, the germination may be low. It is essential every year that grain intended for seeding be tested for germination. You can test at home in sand or soil. Moist blotter tests may be inaccurate because of the difficulty of keeping the blotters moist, and also because normal sprouts cannot be distinguished from abnormal ones that would not survive in the field. Elevator agents will send your sample away for laboratory testing. For an official test, required for seed offered for sale, sample must be sent to the Plant Products Division, Canada Department of Agriculture, Edmonton. The fee for testing cereals is 75 cents for each sample, payable when the sample is submitted.

Seed treatment — Adequate seed treatment is an important aspect of crop production.

There are various materials for seed treatment on the market and farmers should make certain they obtain seed dressings that best suit their purpose.

The following factors should be considered: (1) Follow the directions of the manufacturer. (2) Treat wheat as least 24 hours, and oats and barley at least one week, prior to seeding. (3) Wear a mask when treating seed.

NOTE—More detailed information on diseases, insects, etc., which are important to the production of grain crops may be found in other sections of the Guide. See Index.

Forage Crops

Forage crops are the basis of permanent agriculture and have a place on every farm. They provide the best source of livestock feed and prepare the land for grain crops to follow. They improve soil tilth by their fibre residue and legumes contribute to fertility. Forage crops are widely adapted over Alberta and should constitute a permanent part in the cropping program in all Zones. They provide one of the best known means of weed control and they may also be used for reclaiming watercourses, low areas, alkali lands, field margins and roadsides.

How much of your land should be seeded to grass and legume crops at any one time will depend on where you farm. The map on page 43 will show the Zone in which you are living. Keep in mind that the lines between the Zones are not clear cut.

Zone 1—Regular rotations of grain and forage are rarely followed in Zone 1. With the low rainfall, soil fertility declines slowly and it is often difficult to establish forage stands. Forage crops do, however, have a place in this area. They have contributed to a more balanced type of farming, prevent soil erosion and improve soil structure. A portion of the cultivated land might well be sown to grass periodically and left down for about 5 years. Crested wheatgrass is widely used, particularly for reseeding abandoned wheat land, regrassing overgrazed ranges and for permanent seeding down of light soils that tend to drift readily. The grazing capacity of a good stand of crested wheatgrass is considerably greater than that of native range. Crested wheatgrass and Rambler alfalfa is the best mixture for hay in Zone 1. Russian wild-rye provides a useful summer pasture in rotation with crested wheatgrass. The addition of Rambler alfalfa to these grasses increases pasture quality and production and is a recommended practise despite the bloat hazard.

Sweet clover is also useful in Zone I since it adds nitrogen to the soil. It should be seeded with the last grain crop that precedes summerfallow.

Zone 2 — Better moisture conditions in Zone 2 allow for greater use and wider choice of forage crops. Crested wheatgrass, Russian wild-rye, sweet clover and Rambler alfalfa are suitable in the drier sections. In districts of more plentiful moisture,

alfalfa, bromegrass, creeping red fescue, pubescent and intermediate wheatgrasses and timothy may be grown to advantage. Throughout Zone 2, greater use should be made of sweet clover and alfalfa.

Where forage crops are included in grain-grass rotation they should remain down from three to five years.

Zone 3—There is no part of the province where forage crops play a more important role than in Zone 3. Because of the good fertility and adequate moisture conditions in Zone 3 forage crops provide extensive pasture and hay to meet the livestock needs of a mixed farming economy.

Alfalfa and bromegrass are the most useful forage crops, but all winter hardy grasses and legumes can be grown successfully. Red clover, alsike clover, timothy, pubescent and intermediate wheatgrasses and creeping red fescue all are suitable.

Zone 4—In this Zone—the grey wooded—land that is more than two to four years away from forage should not be seeded to grain. Legumes must be grown if the land is to yield profitably. Since, under natural conditions, the soil contains very little fibre, grasses are essential too. Alfalfa, clovers, brome, timothy and creeping red fescue are all important forage crops in this area.

In the improvement of grey wooded soils, legumes and fertilizer should be used together. Forage yields in this Zone are often more than doubled by fertilizer application. Yields of grain following fertilized legumes usually show marked increases.

Nitrogen, phosphate and sulphur are the main elements usually lacking. Nitrogen can be supplied by growing legume crops but phosphate and sulphur must be supplied in the form of commercial fertilizer.

Irrigated Areas — Irrigation makes possible the use of a wide range of foroge crops in southern Alberta.

Much of the economy of irrigated areas lies in the production of cash crops, which are grown in a rotation system with forage crops. Alfalfa is very important to permanent agriculture in the irrigated areas. It provides the main feed source for livestock, and at the same time acts as the best soil conditioner for other crops. Sweet clover is used in short rotations in conjunction with sugar beet growing.

There has been a marked increase in irrigated pastures, which are now used extensively for beef and mutton production.

Alfalfa is the main hay crop on irrigated land, but brome, creeping red fescue, orchard grass and the clovers, all thrive under irrigation. White clover is an important pasture legume.

Fort Vermilion Area — Rainfall is light but variable, and a tendency towards dry conditions in the early spring exists. The growing season is short restricting forage species to the more hardy varieties of alfalfa, bromegrass, crested wheatgrass and creeping red fescue. A deficiency of soil nitrogen makes alfalfa an essential part of any forage mixture. Nitrogen fertilizer can be applied to advantage on two year old or older forage stands.

FORAGE CROP VARIETIES

Alfalfa does best on moist but well drained soils. Unequalled as a forage crop.

LADAK is sufficiently winter hardy for most areas in Alberta; high in forage yield and partially resistant to bacterial wilt.

BEAVER is equal to Ladak in forage yield but considerably more resistant to bacterial wilt. Recommended under irrigation and in the moist areas of the province.

RAMBLER is a creeping rooted variety especially useful for dry land pasture. It is very drought resistant and winter hardy.

VERNAL has good wilt resistance but lacks hardiness for areas outside the irrigation districts.

GRIMM is a hardy high yielding variety but susceptible to bacterial wilt.

Alsike — useful where moisture is adequate; on low lands, in areas subject to flooding, and irrigated areas.

AURORA is the recommended variety.

Red Clover — adapted generally to the grey wooded and black soils. Requires ample moisture and good drainage. Thrives under irrigation.

ALTASWEDE is a single-cut red clover. It is a tall-growing, late-maturing, high yielding variety with moderate resistance to disease.

LASALLE is a double-cut red clover. It is appreciably less winter hardy than Altaswede; a factor that accounts for its lower production of forage in the central and northern parts of Alberta. It is approximately 12 days earlier in blooming than Altaswede.

Sweet Clover — a biennial crop of wide adaptation. Useful as a fodder crop and in rotations as a green manure crop. Once established is fairly alkali tolerant.

Sweet clover seeds are protected by an impervious hard coat and only scarified seed should be sown. Land contaminated by unscarified seed is subject to recurring growth of sweet clover making it unsuitable for seed production of alfalfa and red clover.

(a) White Blossomed

ARCTIC is the standard white blossomed sweet clover for western Canada. It has winter hardiness, medium fine stem, leafiness and high forage yield. It is a few days earlier in maturity than common white.

CUMINO was developed for freedom from coumarin. It is winter hardy.

(b) **Yellow Blossomed**

ERECTOR is much more uniform and somewhat more upright than common yellow and is higher yielding. It flowers a few days earlier than Arctic.

White Clover—(commonly called White Dutch Clover). An important irrigated pasture legume and also used in more moist areas of Zones 3 and 4. Ladino, a more productive white clover, lacks winter hardiness and is limited to the irrigated districts.

PILGRIM hardiest variety of the Ladino type.

Smooth Bromegrass—The most commonly used grass in Alberta. Adapted to a wide range of soil and moisture conditions but thrives particularly well on moist, well drained soil. It is a hardy long lived, high yielding, creeping rooted perennial, makes good summer pasture and excellent hay.

CARLTON vigorous northern type, produces excellent seed and forage yields.

MANCHAR intermediate type, particularly suitable for pasture in mixtures with legumes.

OTHER varieties are grown in Alberta mainly for the export seed trade. These include Saratoga, Fischer, and Lincoln.

Creeping Red Fescue — A useful grass except where moisture is limited. Good pasture from spring to late fall and even used for winter grazing. One of the best cultivated pasture grasses in the foothills. Forms a dense turf that withstands severe trampling.

OLDS uniform high yielding variety adapted to all of Alberta.

DURATURF similar to Olds in growth habit and yield.

Crested Wheatgrass—Thrives on the dry, open plains, and on sandy soils in other areas. Makes early spring and late fall growth. Extensive root system. It is one of the best grasses for the drier areas of western Canada and has performed well as pasture and as hay in the parkbelt region. Produces well in mixtures with alfalfa in all Zones.

SUMMIT high yielding hay and pasture type.

NORDAN similar in forage yield and type to Summit but better seed producer.

FAIRWAY a fine stemmed lower yielding variety useful for dry land lawns and roadside seeding.

Intermediate Wheatgrass—Grows well in most areas where bromegrass is adapted, but is not equally winter hardy. Excellent for seeding down permanent waterways. Makes good hay and pasture.

CHIEF high yielding variety.

Pubescent Wheatgrass — Large seeded, strongly creeping perennial, suitable for waterways and erosion control. Very easy to establish and has early spring growth. Produces good hay and pasture yields.

Slender Wheatgrass—Short lived perennial adapted to moderately alkali areas. It produces high quality hay and fair pasture.

Tall Wheatgrass—Most alkali tolerant of cultivated grasses in Alberta. Withstands spring flooding. Subject to winter killing.

Orchard Grass — Excellent grass under irrigation and the basis of permanent pasture mixtures in irrigated areas. Is high yielding and has most rapid recovery after grazing. Grows well in the moist areas of the southern half of Zone 3.

CHINOOK is by far the most winter hardy variety. Early spring vigor is one of its attractive features. It is the only recommended variety in Alberta. Northern limits of adaptation not established.

Timothy—Likes rich, moist soils and cool temperatures. Suitable for hay in short rotations in Zones 3 and 4. Survives spring flooding and wet conditions.

CLIMAX is a tall, upright, relatively fine stemmed leafy variety. Late maturing.

Russian wild-rye—Very drought tolerant and an excellent pasture grass for the dry and semi-dry areas of the province. It should be grown in a mixture with Rambler alfalfa for maximum production. Russian wild-rye is characterized by poor seedling vigor and therefore is often difficult to establish. Makes excellent summer and late fall pasture.

Reed Canarygrass — Very tolerant of flooding and some alkali tolerance. Develops a tough sod, makes good pasture, but a coarse hay. It is used in combination with alfalfa for hay under irrigation.

SEEDING PRACTICES

Seeds of different varieties look alike and varieties cannot be identified on the basis of seed characteristics. Only by purchasing Certified seed can you be sure of getting the performance you expect from the variety selected. Certified seed has a pedigree that can be traced by record to the Plant Breeder stock. For complete confidence in your seed purchase, ask for Certified seed, it has varietal purity guaranteed as well as freedom from weeds and diseases.

SEED BED PREPARATION

A firm clean sed bed is essential. In areas where soil drifting is a problem some form of protection must be provided for the seedlings. This is best accomplished by seeding into clean undisturbed grain stubble. Where stubble is not available a light seeding of oats will provide protection (see Companion Crops). In other areas clean fallow land is suitable.

RECOMMENDED LEGUMES FOR ALBERTA

KIND	ZONES	MOISTURE CONDITIONS	VARIETIES	MAIN USES	REMARKS
Alfalfa	1,2,3,4,Ir.	Moderate to moist	Beaver	Hay	Hardy, wilt resistant.
		Moderate to moist	Ladak	Hay	Hardy, partially wilt resistant.
		Moderate to moist	Vernal	Hay	Mod. hardy, mod. wilt resistant.
		Moderate to moist	Grimm	Hay	Hardy, wilt susceptible
		Dry to moist	Rambler	Hay and pasture	Hardy, wilt susceptible
White clover	Ir.	Moist		Pasture	Palatable — low yield.
Ladino white clover	Ir.	Moist	Pilgrim	Pasture	Palatable — high yield. periodically winter-kills.
Red clover	3,4,Ir.	Moist	Lasalle	Hay and seed	Subject to winter-killing.
			Altaswede	Hay and pasture	Widely used in short rotations.
Alsike	3.4.Ir.	Moist	Aurora	Hay and pasture	Adapted to wet areas.
Sweet clover (white)	1,2,3,4,Ir.	Dry to moist	Arctic	Hay, pasture Green manure	High yield — coarse.
			Cumino	Hay and pasture	Coumarin free — poor seeder.
Sweet clover (yellow)	1,2,3,4,Ir.	Dry to moist	Erector	Hay and pasture Green manure	Early — high yielding.

RECOMMENDED GRASSES FOR ALBERTA

KIND	ZONES	MOISTURE CONDITIONS	VARIETIES	MAIN USES	Best Time to Graze Sp.	Su.	Fall	Winter	REMARKS
Brome	2,3,4,Ir.	Moderate moisture	Carlton Saratoga	Hay & pasture Seed	x	x			Most etensively used grass in Alberta
Crested wheatgrass	1,2,3	Dry to moist	Nordan Summit Fairway	Hay & pasture Hay & pasture Lawns & roadways	x x		x x		Excellent dry land gras—easy to establish.
Creeping red fescue	2,3,4,Ir.	Moderate moisture	Olds Duraturf	Pasture-lawns Pasture-lawns	x	x	x	x	Best cultivated pasture grass for foothills area.
Bluegrass	3,4,Ir.	Moist	Merion Kentucky	Lawns-seed Lawns					
Intermediate wheatgrass	2,3,4	Moderate moisture	Chief	Hay-pasture		x	x		Recommended for erosion control.
Orchardgrass	2,3,4,Ir.	Moderate moisture	Chinook	Pasture	x	x	x	x	Most productive irrigated pasture grass.
Pubescent wheatgrass	2,3,4,Ir.	Moderate moisture		Hay, pasture, erosion control	x	x	x	x	Strong seedling vigor, easy to establish.
Reed canarygrass	2,3,4,Ir.	Dry to wet		Hay, pasture	x		x		Wet and moderate alkali condition. Most tolerant of flooding.
Red top	3,4,Ir.	Moist to wet		Hay, pasture	x		x		Withstands flooding, short lived.
Russian wild-rye	1,2,3	Dry to moderate moist		Pasture		x	x	x	High protein grass. Hard to establish.
Slender wheatgrass	2,3,4	Moderate moisture	Primar	Hay & pasture	x	x	x		Alkali conditions.
Tall fescue	2,Ir.	Moderate moisture	Alta	Hay & pasture	x	x	x		Alkali conditions.
Tall wheatgrass	2,3,4,Ir.	Moist		Hay & pasture	x	x	x		Most alkali tolerant and withstands wet conditions.
Timothy	3,4	Moist	Climax	Hay & pasture	x	x			Wet conditions.

SUGGESTED MIXTURES OF GRASSES AND LEGUMES — FOR PASTURE

Mixture	lb. seed per acre	Adaptation
1. Rambler or Ladak alfalfa	2–3	For all but drier parts of the province.
Bromegrass	6	
Creeping red fescue	3	
2. Rambler or Ladak alfalfa	3	Zones 2 and 3.
Bromegrass	8	
3. Rambler or Ladak alfalfa	3	Zones 2 and 3.
Nordan or Summit crested wheatgrass	3	
Bromegrass	6	
4. Rambler alfalfa	2	Zone 2.
Russian wild-rye, Nordan or Summit crested wheatgrass	6	
5. Nordan or Summit crested wheatgrass or Russian wild-rye	6	Driest area.
Rambler alfalfa	1	
6. Bromegrass	12	Short-term pasture under irrigation.
Beaver, Ladak, Vernal or Grimm alfalfa	2	
7. Bromegrass	7	Long-term pasture under irrigation.
Creeping red fescue	4	
Chinook orchardgrass	7	
White Dutch clover	2	

FOR PASTURE OR HAY

Mixture	lb. seed per acre	Adaptation
1. No. 1 Pasture Mixture		For all but the drier parts of the province.
2. Rambler orf Ladak alfalfa	3	For Zones 2 and 3 where moisture conditieons are variable.
Bromegrass	5	
Nordan or Summit crested wheatgrass	3	
3. Alsike clover	2	Suited to wet locations subject to flooding.
Frontier reedcanary grass	5	
Climax timothy	1	
4. Alsike clover	2	For acid soils subject to flooding.
Red Top	5	

FOR HAY

Mixture	lb. seed per acre	Adaptation
1. Rambler or Ladak alfalfa	5	Recommended for same areas as No. 1 Pasture Mixture.
Bromegrass	6	
2. Rambler or Ladak alfalfa	5	For Zones 2 and 3.
Nordan or Summit crested wheatgrass	6	
3. Rambler or Ladak alfalfa	3	For Zones 2 and 3 where moisture conditions are variable.
Bromegrass	5	
Nordan or Summit crested wheatgrass	3	
4. Beaver, Ladak or Vernal alfalfa	5	Areas of plentiful moisture.
Climax timothy	3	
5. Altaswede red clover	5	Grey Wooded or Black Soil areas of plentiful moisture.
Bromegrass	6	
6. Altaswede red clover	5	Grey Wooded or Black Soil areas of plentiful moisture.
Climax timothy	3	
7. Alsike clover	4	Wet locations subject to flooding.
Climax timothy	3	
8. Alsike clover	4	Areas subject to prolonged flooding.
Frontier Reed canarygrass	3	
Climax timothy	1	
9. Beaver or Vernal alfalfa alone		Preferred hay crop in irrigated areas.
10. Nordan or Summit crested wheatgrass	3	For driest areas.
Bromegrass	5	
Rambler alfalfa	2	

COMPANION CROPS

In general, companion crops are not recommended as they provide too much competition to the forage seedling. Under drifting or eroding conditions companion crops hold the soil until the forage crop is established. Where used, the recommended crop is oats at one-half the usual rate seeded in a separate operation from the forage crop. The oats should be cut and removed as green feed.

INOCULATION

All legumes should be inoculated when seeded, especially on new land. Recommended inoculants are available from seed houses and should be applied just prior to seeding.

TIME TO SEED

Seeding to coincide with favorable moisture conditions is the most important factor in establishing forage stands. In general it can be done at three times of the year.

(a) Spring Seeding — In Zones 1 and 2 forage seeding should be early to take full advantage of spring moisture. Throughout Zones 3 and 4 spring seeding of forage is most successful, but should not be considered later than mid-June.

(b) Early Fall Seeding — In Zone 1 and the southern half of Zones 2 and 3 early fall seeding is particularly suitable for all forage crops except sweet clover. It is hazardous during severe grasshopper outbreaks and should not extend beyond September 15th. Where used in Central Alberta, early fall seeding should be completed by August 15.

(c) Late Fall Seeding — (Just before freeze-up) is useful for placing seed in the soil for spring germination. This method is mostly used for seeding crested wheatgrass in the drier areas and for seeding reed canarygrass in areas subject to spring flooding.

SEEDING

Shallow seeding is essential. The grain drill is satisfactory and special adaptations are available to improve its use. One of the most useful is the flange for the discs to prevent seeding too deep. The main drill box can be used if a filler, such as cracked wheat, is mixed with the seed to maintain constant flow. Broadcasting should only be done where it is impossible to use the drill. Forage seeders are available.

MANAGEMENT OF CULTIVATED PASTURES

The following principles of pasture management are suggested to obtain maximum production.

1. During the seedling year effort should be made to provide most favorable conditions for the establishment of the grass and legume. This can be done by clipping weeds to reduce competition; where a companion crop is used it should be removed as early as possible for the same reason. Where growth warrants pasture plantings can be grazed late the first year if they are not over-grazed or animals left on wet fields to cause damage by trampling.

2. Do not graze too early—always allow the forage growth to reach a minimum of 4 inches before turning stock in to graze.

3. Controlled rotational grazing using three or four fields provides the stand with periods of rest and recovery. The plants are grazed at their most palatable and nutritious stage of growth. As the stock are moved off the pasture ungrazed growth should be clipped and droppings spread by harrowing.

4. Pastures are most productive in June and surplus growth at this time of year should be harvested for hay or silage.

5. The value of a legume, such as clover or alfalfa, in stimulating pasture growth cannot be over-emphasized . The proportion of legume to grass can be regulated by careful use of commercial fertilizers. Nitrogen fertilizers stimulate grasses while phosphates promote legume growth.

6. On irrigated pastures rotational grazing is essential. Maximum production is obtained by the quick removal of top growth and allowing at least three weeks for recovery before regrazing. Rotational grazing with a minimum of four fields is recommended. Fields should be of a size that can be grazed off in a very few days. Following each grazing the field should be cut with a mower to remove excess growth, harrowed to break up droppings, and irrigated. Excess pasture in the spring should be harvested for hay or silage.

ANNUAL PASTURE

Annual pasture crops are useful for supplementing perennial pastures and for intensively grazed areas such as paddocks, hog pastures and poultry runs.

1. Oats, or oats and fall rye in mixture, are favored for annual pasture. These crops should be sown in late May or early June so as to have them in the boot stage and ready to pasture by late July when other pastures are past their best.

2. Cover crops, originally used to prevent soil drifting in Southern Alberta, are now grown extensively for fall finishing of beef cattle in the farm land adjoining the foothills areas. Oats seeded at a rate of a bushel per acre during the last half of July is the most satisfactory cover crop. Cattle are moved in when the oats are from 12 to 15 inches high.

3. Pasture rape — Dwarf Essex or Gartons' Early Giant at 4 to 5 pounds per acre

under-seeded in wheat provides fall pasture for sheep or hogs after the grain is harvested.

HAY CROPS

Hay is the basis of livestock feeding and serves also as a cash crop on irrigated land. High quality hay is essential and quality is affected by a number of controllable factors.

QUALITY

Hay quality is generally determined by leafiness, color, palatability and the amount of foreign material. As most of the nutritive value of the plant is contained in the leaves, leafiness is the most important single factor. Hay in which the leaves have been lost during harvesting is of relatively low quality.

A bright green color is associated with high feeding value. There is usually a correlation between the green color and the quantity of carotene or vitamin A in the hay. Visual observation of hay can only be considered a rough guide to its quality. A laboratory test should be obtained to determine feeding value. Such information is essential to an intelligent approach to feeding practices.

Weeds and foreign material such as dry stems of the previous year's growth and stubble lower the feeding value.

The following management procedures are offered for the production of high quality hay.

Good stands are the best insurance against weeds or foreign material in the hay crop. Stands seeded at the recommended rates on clean land will produce the greatest amount of stem and leaf growth, while overthick stands will become very fine stemmed and yield much less. Irrigation, fertilization and cutting practices should be complete and uniform so that the whole crop will be at the same stage of growth and maturity at the time of cutting.

MANAGEMENT

Time of cutting varies with the crop but is determined by the stage of growth. With alfalfa the best time is the 10 per cent bloom stage combining high yield with high protein content. This is more important than higher tonnage of lower quality.

Grasses vary, but in general they should be cut between the time of heading and full bloom. Beyond the full bloom stage much of the protein content of the leaves is transferred to both the roots and the seed with a consequent decrease in the value of the hay.

Curing and Handling — Rapid curing is the key to top quality hay. Alfalfa at the time of cutting usually contains 70 to 80 per cent moisture and about 12 per cent when thoroughly air dry. It can be safely stacked at about 25 per cent moisture, and baled at about 20 per cent moisture. Handling when dry results in a shedding and loss of leaves so that haying operations should be carried out while the crop is still tough. Cutting in excess of the amount that can be raked and baled the following day means that some of the hay will lie too long in the field and will be either too bleached or too dry to handle. At the same time there is a risk of the cut crop being caught by adverse weather.

Excessive handling is the main cause of loss of leaf between cutting and marketing. Hay should be handled as little as possible and while it is still tough. First drying should be done in the windrow rather than in the swath. This can be done by cutting with a swather or raking directly behind the mower.

Storing — Most hay is stored either in the loose stack or field baled and stacked. Loose stacked hay can go into the stack slightly more moist than the baled.

In general the sweep rake and stack are used for rapid stacking. Baling directly from the windrow is now common practice in Alberta. Here, sufficient attention should be given to moisture content as the baling of over-dry hay results in excessive loss of leaves and baling of under cured hay may result in heating and moulding.

Prompt stacking and proper capping of stacks, whether of loose or baled hay, is a safeguard against weather damage. To further retain quality, some producers use open hay sheds and plastics or canvas covers.

Artificial Dehydration — Artificial dehydration is limited to production of dehydrated alfalfa for high quality and high protein. The alfalfa is harvested in the pre-bud stage and hauled to the dehydrator where it is rapidly dried and converted into alfalfa meal. Distance from field to dehydrator is a limitation since quality of the produce and efficiency of the operation are reduced by long hauls.

SILAGE

Ensiling is an excellent way of preserving the feed value of a forage crop when it is not possible to make good hay. Silage has other advantages as well, such as:

1. Unpalatable components of a feed are made more palatable.
2. The fire hazard is eliminated.
3. Many weed seeds are killed.
4. Leaves are more easily retained.
5. Carotene content is usually high.

Some disadvantages of silage are:

1. It is bulky to handle both in preserving and feeding.
2. More exacting storage is necessary than that required for hay.

Silage has been made from many different crops such as corn, cereals, grasses, alfalfa, sweet clover, sunflowers, beet tops and pea vines. The important consideration for conventional ensiling methods is that the moisture content of the crop be between 65 and 70 per cent. With too little moisture moulds are likely to develop and with too much moisture there is an excessive loss of nutrients in the liquid that runs from the bottom of a silo. Crops in the hay stage have about the right amount of moisture, with a few exceptions. Grasses growing under very dry conditions may be too dry and immature forage growing on irrigated land could be moist enough to benefit from a short period of wilting in the windrow. If free liquid can barely be squeezed by hand from the chopped material the moisture content will be about right.

Some adjustment in the moisture content of the crops is possible while the silo is being filled. Water can be added to crops that have become too dry, although the forage must still have some succulence of its own. Wet crops will benefit from the addition of a drier feed, such as hay or grain that will absorb some of the excess moisture.

The ensiling process depends on the presence of carbohydrates for good fermentation. Crops low in carbohydrates such as legumes, and to some extent grasses, will make better silage if a conditioner is added. Ground barley or beet tops at 150 pounds per ton of silage or molasses at 80 pounds per ton are good conditioners. Well matured corn does not require a conditioner.

The basic objective in silage making is to exclude air from the fermenting fodder, and anything that will facilitate this is worth considering. Packing is a very effective means of excluding air and is quite sufficient if well done. There is no possibility of too much packing; only too little.

In tower silos the bottom 2/3 is packed by the weight of the material above and only the upper portion requires special attention. Air tight silos are available and require no packing at all, but they are rather costly which limits their popularity. The more common trench or bunker type silos are usually packed by driving a tractor over the material as the silo is being filled and continuing packing for three or four days after filling or until no further settling occurs.

It is a good idea to deposit a two-foot layer of unpacked material on the floor of the silo a day or two before the main operation is begun. After this layer has dried a little and begun to heat it can be packed thoroughly and will then act as an absorbent for liquid that seeps down from the silage above. In packing the trench or bunker silos special attention should be payed to the edges to prevent the formation of air pockets. It is particularly important to avoid drying on the sides exposed to the wind and sun. A final covering of the top with any convenient material that will reduce air exposure will hold spoilage to a minimum. Hay, straw, plastic or tar paper sheets, weeds, germinating cereals, soil and many other things have been used for this purpose.

The shape of the silo should be such that at least 4 inches of silage will be removed from the exposed surface each day of the feeding period. Well packed silage weighs 35 to 45 pounds per cubic foot, so if the daily consumption can be predicted the best size and shape of silo can be calculated. With a bunker silo it is convenient to self-feed cattle by hanging a gate from a movable pole suspended by the two walls. The gate will be pushed ahead by the animals as they eat, although some restrictions will be necessary at times to force cleaning up of the less excessible feed. The silo should have a minimum width of 1 foot of face for every three mature animals being self-fed.

TEMPORARY SILOS

Emergency means of ensiling a crop are often useful but they should not become regular practice. The annual cost of a temporary silo might be low, but over a period of years it could well exceed that of well constructed storage. Also, the amount of spoilage is often very high in hastily constructed silos and although the financial loss might not be apparent it is very real.

Temporary walls can be constructed of bales of straw or hay; snow fence lined with tar paper, plastic sheeting or bales; old buildings or anything else convenient. If no wall is available the forage can be deposited in a mound, over which a tractor can be driven in many different directions for packing. It should be noted that spoilage can exceed 50 per cent in this method. Spoilage will be minimized by covering the silage tightly with a plastic sheet and evacuating the air underneath, but this again increases cost.

CROPS

Some of the more important silage crops and special considerations for them are:

1. Oats. Seed about 20 per cent heavier than for grain and harvest when in the milk stage. The late varieties will give the highest yields.

2. Alfalfa. Cut at the 10 per cent bloom stage or later and add a grain conditioner.

3. Corn. Harvest when the grain is well-dented and firm but the leaves are still green. Use an early hybrid. Corn has a good potential in the irrigated area of southeastern Alberta, but its usefulness is

questionable in other parts of the province. Under irrigation 20,000 plants per acre will give a good yield, well balanced between stock and ear. About ¼ bushel of seed per acre will be required.

4. Spring Pastures. If more succulent forage is available than can be utilized in spring it can be preserved very effectively as silage. Usually no preservative is necessary although chopped grain may improve it.

SPOILAGE IN SILAGE

1. Mouldiness — Due to lack of packing, material too dry, or both. May be avoided by more thorough packing and adjusting moisture to 65 to 70 per cent.

2. Over-heating — Brown or black silage sometimes having a "tobacco" odor. Caused by too much air in silage or material too dry. Need for better packing indicated.

3. Cold or rotten silage — Cold silage is a result of ensilage material going into the silo too wet. This can be prevented by adding a conditioner such as ground grain or wilting the material. Allow the first foot of material to start heating before continuing to fill silo. Rotten silage is usually due to moisture entering silo from inadequate capping.

4. Sliminess — Usually associated with black color and putrid odor. Caused by too high a protein level in relation to sugars and starches. To avoid add a preservative such as ground grain or molasses, etc.

NATIVE HAY AND PASTURE LAND

Native grasslands in Alberta vary with soil and climatic conditions. They are classified as:

1. Tall or fescue grassland.
2. Mixed.
3. Short.

The Fescue Grassland includes the black soil zone and parkland areas of southwestern and central Alberta. It also occurs in the Cypress Hills of southeastern Alberta. In fescue grassland rough fescue is dominant with porcupine grass, wheatgrasses, oatgrasses, and June grasses also occurring. In the Porcupine Hills, Parry's oatgrass and Idaho fescue form an important part of the cover. Forbs and shrubs are common and may become serious range weeds under heavy use. The more important include shrubby cinquefoil, western snowberry, and rose.

Fescue grassland is well supplied with stock water through springs and creeks. A major problem, because of the steeply rolling nature of much of the zone, is uniform distribution of grazing animals. Salting away from water will help. Poplar and willow growth provides stock shelter.

The Mixed Prairie and Short Grass Plains is the treeless prairie of the brown and dark brown soil zones in Alberta. A portion in extreme southeastern Alberta is often referred to as the "Short Grass Plains" but differs from the remainder only in the relative abundance of individual species. The main grasses are blue grama grass (dominant in the "Short Grass Plains"), spear grass, June grass, wheatgrasses and porcupine grasses. Common forbs include fringed sage, broomweed, crocus, and silver sage, while rose and hoary sage are the more important shrubs. When constantly over-grazed, blue grama grass and fringed sage dominate with an understory of club moss.

The Provincial Department of Lands assesses lease lands on their ability to produce beef. Consequently, the province is partitioned into zones in which the grazing rates range from 24 acres per head per year to 60 acres per head per year.

In general this is divided into equal acreage for summer grazing and winter feed. These rates are calculated to maintain an excellent vegetative cover under normal climatic conditions for the zone.

At Stavely, on excellent range and better than normal rainfall, the best rate of grazing for the past 10 years has been between 9-10 acres per head for a six-month grazing period.

While these established rates are general for the zone, the rate of grazing on the individual range is governed by the vegetative cover and the annual production.

The most common rule for grazing is to "Use half — leave half." Fifty per cent carryover allows for cover improvement and production increase.

Management of Native Range

If ranges are heavily grazed, the palatable plants are killed, and replaced by weedy, unpalatable, non-productive species that produce ideal breeding grounds for destructive insects. Over-grazed range land is subject to water erosion. It does not retain enough cover to catch and hold snow and favors loss through run-off of summer rains.

Uniform grazing is often difficult since the natural tendency of cattle is to feed along coulee bottoms and around water holes. Water holes placed from 1 to 1½ miles apart will keep livestock scattered. Salt licks away from the watering places, and scattered shelters in treeless areas also encourage best range use. Salt licks should be moved at intervals to prevent localized abuse of the vegetation. Knowledge of the range and of livestock habits can do much to secure uniform distribution.

The management of native hayland is a problem only in areas of good moisture. On the dry plains, haying is confined to depressions and other favorable locations and

can be practiced anytime the growth warrants. In the foothills, Cypress Hills, and similar areas, the general practice is to cut upland hay only in alternate years. Cutting more often results in damage to rough fescue particularly, with a consequent drop-off in yield of hay.

When native grass hay is cut late in the season the feeding value may be reduced to the point where it is not much better than wheat straw.

FORAGE SEED PRODUCTION

Forage seed production is a specialized type of farming program. It requires an understanding of cultural principles and a thorough knowledge of seed standards and regulations as established by the Canadian Seed Growers' Association and the Canada Department of Agriculture.

Many forage crops are cross-pollinated. In addition many crops have seeds similar in size and shape making separation difficult. Therefore, it is essential to have adequate isolation in order to produce pure seed. While most forage crops can be grown successfully throughout the province seed production should be attempted only where this is assured.

Meticulous cleaning of all equipment is required to further prevent mixing or contamination of the seed crop.

SEED

Seed producers should use only the highest grade of seed obtainable. Choice of variety requires careful consideration. The selection should be one that will have popular demand to ensure sales and possibly better prices. Buyers of forage seed are becoming more variety conscious and growers should be sensitive to their demands.

SEEDING

Forage seed should be produced on clean land.

Row seeding usually results in higher yields than broadcast or close seeding but it has some cultural disadvantages. Extra labour is required to cultivate rows, and swaths are harder to pick up. A satisfactory compromise is to plug every second drill so as to have rows 12 to 14 inches apart. Seed production in drier areas requires wider row spacing for maximum yields. (See previous section on "Seeding").

POLLINATION

All legume crops grown for seed in Alberta **must be cross-pollinated by bees.**

Sweet clover and alsike are the favorite food sources of honey bees. The acreage devoted to seed production of either of these crops should depend on the number of honey bees in the area. For good pollination, there should be at least one strong hive for every acre of alsike or sweet clover. Since honey bees prefer sweet clover, alsike seed production will suffer if sweet clover is grown nearby.

Red clover is pollinated by bumble bees and honey bees. It must be isolated from sweet clover and alsike to obtain the services of honey bees and of some bumble bees and it should be grown next to the bush or prairie in which bumble bees nest. Because honey bees do not obtain nectar from red clover, bee-keepers do not want to place their hives beside red clover fields without payment. If a red clover field is isolated from sweet clover and alsike, it will pay to hire the services of bees. Such payment should be based on the loss of surplus honey by the beekeeper and the gain in pounds of seed by the seed grower.

Alfalfa is pollinated by leaf-cutter bees and bumble bees. In Alberta, honey bees are of little use for alfalfa pollination. To obtain the services of bumble bees, alfalfa must be isolated from red clover, alsike, and sweet clover. These crops do not compete with alfalfa for the services of leaf-cutter bees, but there are seldom enough leaf cutters to produce a good crop of seed by themselves.

Therefore, it is necessary to use all the bumble bees and leaf-cutter bees in the area. This can be done by growing alfalfa in as long and as narrow a strip as possible next to bush or prairie, and by isolating it from other legume seed crops. Acreages of alfalfa for seed should be small. There will seldom be enough wild bees within flying range to pollinate more than 20 acres.

A knowledge of the likes and dislikes of the different kinds of bees in Alberta makes it clear that legume seed growing must be put on a community basis. Honey bees cannot be confined to the fields beside which they are put. Red clover and alfalfa must not only be isolated from other competing crops; they must also be isolated from wild competitors like thistle and fireweed. The less bloom there is of other plants in an area, the better will be the chances of obtaining seed crops of commercial importance.

FERTILIZERS

Fertilizer use means better seed yields. (See sections on "Fertilizer," pages **13-15.**)

ROGUEING

Rogueing is a must for high quality production. This means removal, by hand, of off-type plants and any weeds or other crops which may be difficult to clean out of the seed.

HARVESTING

Straight combining of forage crops is generally not recommended since forage seed usually shatters readily. If this is the

method chosen, it should be done before the crop is dead ripe, and some provision made for drying the seed before storage.

Swathing and pick-up is the most common method of harvesting, although binding and threshing is equally good. For combine or thresher settings follow the instructions of the manufacturer. Some important thumb rules in threshing are:

1. Run the cylinder at the slowest speed that will remove the seeds from the heads. This will break fewer stems and leaves and make separation much easier.
2. Never overload the machine.
3. Rub-bar cylinders are usually preferred to the toothed type.
4. Repair leaks that can result in heavy losses of seed.
5. Clean the combine thoroughly before moving from one kind of crop to another. Admixtures can degrade seed.

STORING

Freshly harvested seed is often high in moisture and is subject to heating which may destroy germination. Adequate drying is necessary before storing. If seed is to be stored in sacks for any length of time, some protection from mice must be provided. Fifty per cent wettable D.D.T. powder spread around the sacks so that the mice must walk on it will provide effective and economical protection. Storage must be dry and care taken to prevent snow or rain from reaching the sacks.

CLEANING

Cleaning forage seed is difficult and requires specialized equipment. Only rough cleaning to remove excess dockage should be attempted on the farm. For final cleaning to highest possible grade, the seed can be shipped to one of the many commercial concerns operating efficient, well-equipped plants.

NOTE: More detailed information on diseases, insects, etc., which are important to the production of forage crops may be found in other sections of the Guide. See index.

REFERENCES :

Department of Agriculture, Edmonton.

Circular 63 — Hay and Pasture Crops for Alberta.
Publication 100 — LaSalle Red Clover Seed Production.
Publication 108 — Grass Silage for Alberta.
Publication 136 — Range, Its Nature and Use.
Publication 142 — Pollination of Legumes.

University of Alberta, Edmonton.

Circular 4 — Legume Inoculation.

Department of Agriculture, Ottawa.

Publication 753 — Hay Making With Crested Wheatgrass in the Dry Areas of Alberta.
Publication 860—Annual Crops for Hay and Pasture.
Publication 866—Brome Grass Seed Production in Western Canada.
Publication 980—Pasture and Hay Crops for the Southern Canadian Prairies.
Publication 998—Sweet Clover in Western Canada.
Publication 984—Alfalfa Seed Production in the Prairie Provinces.
Publication 1100 — Row Spacing Affects Yields of Forage Grasses.
Publication 1132 — Forage Crops for Irrigated Land.
Publication 1133 — Range Management of the Grasslands and the Adjacent Parkland in the Prairie Provinces.
Publication 1152 — Growing Irrigated Crops in Southern Alberta.

Horticulture

TREES AND SHRUBS

Planting Suggestions—It is important to obtain the best nursery stock recommended for your particular horticultural zone (see "Alberta Horticultural Guide"). Vigorous, well matured planting material will withstand transplanting better and is more resistant to pests and diseases. Autumn-planted trees are subject to winter injury, so in Alberta sprng planting is preferred for most trees and shrubs. If trees are planted during the fall they should be well watered until freeze-up. Deep plowing in October and leaving the soil rough over the winter is beneficial especially with heavy clay soils. Lay out and stake the planting area before digging planting holes.

Planting Holes—When digging holes, it is recommended that the top-soil be kept separate from the subsoil. Size of hole depends upon the age of the tree and root development but should be large enough to receive the roots without bending. The moisture holding capacity of the soil can be improved by mixing organic matter with the top-soil.

Care of Nursery Stock Before Planting—On receipt of planting material the packages should be opened and moistened at once then transplanted. Avoid unnecessary exposure to wind and sun. If the trees or shrubs cannot be planted immediately they should be "heeled in" by placing them in a trench on the north side of a building or shelterbelt. In this position the roots can be covered and packed with moist soil.

Setting the Trees—Trim any broken or ragged roots with a sharp knife or pruning shears. Set the roots to stand in their normal position. Plant the trees about two

inches deeper than they stood in the nursery row. Trees are usually slightly inclined towards the prevailing wind. Use top-soil as much as possible for back-filling the holes. The soil should be packed firmly around the roots, layer by layer. A depression of approximately one inch must be left for watering. Failure is usually due to insufficient compacting of the soil in planting. Water newly planted trees well. To avoid excess evaporation, keep the top-soil loose and possibly provide a mulch or covering such as peat, lawn clippings, or evergreen boughs.

Feeding—Newly planted trees should be fertilized in the spring with 2 lbs. fertilizer per tree. Recommended are 6-10-4, 4-10-8 or 5-10-5. Maintain shallow cultivation of the planted area for the first 3-4 years. Established trees (five years and older) are supplied with 1½ to 2 lbs. of fertilizer per inch of tree diameter measured at three feet above the ground. For established trees punch holes 15 inches deep (1½ inch diameter) and 18 inches apart in two concentric circles of which the outer circle is the circumference of the crown projected on the ground.

Pests and Diseases—See Plant Diseases and Crop Insects, pages 74, 88-90.

PRUNING

Deciduous Trees—Pruning is an art in itself and is often overpractised. Trees in spacious surroundings require the minimum of pruning and it is only justified to remove dead and injured wood, to prevent weak and narrow crotches, to distribute the number of main branches on the trunk and to remove crossing and interfering branches. The best season for pruning is early spring.

When pruning, cut the branches close to their origin. Do not leave stubs; they do not heal readily and are subject to infection. Large limbs should be pruned by means of a double cut, started with a cut on the lower side of the branch at a distance of 10 inches from the trunk and another immediately above, slightly closer to the trunk. After the branch has been removed, the stub can be sawn off close to the trunk.

Shrubs—Most shrubs are pruned early in the spring before the buds break, but spring flowering shrubs, such as lilac are pruned immediately after flowering. In many cases, remove only unwanted branches at the base. Heading-back of branches is only recommended when dealing with formal shapes, such as hedges, where the natural shape of a shrub is not preserved.

Evergreens—Evergreens are slow growers and pruning should be done with extreme care. Mugho pines must be pruned each year to maintain their dwarfing habit. The terminal spring growth should be headed back by two-thirds, before the buds open. No additional pruning should be attempted. Fir and spruce can be handled in a similar way. Do not remove lower branches of spruce, pine and fir.

Apple—On planting a one-year old apple tree, the whip should be headed-back to a height of 15 inches with a terminal on the windward side. The main trunk of a well-established second-year old tree is again cut back leaving a terminal bud on the leeward side. The future scaffold limbs must be headed back to promote spreading. The location of the new terminal bud will determine the direction of the new shoot. During the second year the leeward side bud will develop into a new leader whereas the next lower bud will yield a shoot which is growing away from the main stem. Pruning of a three-year-old tree consists of heading back the new leader and the lower shoot. Side branches are cut back and those with narrow crotches are removed. Crotches are considered narrow when the angle is less than 45°. During later years a main leader developing in the windward direction is of importance together with 6 to 8 vigorous branches 6 to 12 inches apart and well distributed around the trunk. Heavy pruning will delay fruit bearing, hence, later pruning has to be carried out very carefully, improving particularly the secondary framework of the tree.

Plum — Pruning should be light. The main leader should not be headed-back within the first three years. Existing side branches of two-year-old trees are to be developed as scaffolds and are headed-back to approximately 15 inches.

Sour Cherry—On planting, the trees are headed-back to 24 inches. Four to five thrifty, well placed branches will make a good framework with the lowest branch facing the south-west. Yearly pruning is needed for good fruit setting.

Sand Cherry—This type of cherry fruits on one-year-old wood and hence, pruning is necessary to promote shoot development. Two- and three-year wood should be headed-back severely every year.

Wound Dressing—Treat wounds over 1½ inches in diameter with commercial asphalt compounds or with a Bordeaux paste made from linseed oil and Bordeaux powder. Apply paste to the cut area without spreading over the adjoining bark.

SHELTERBELTS

General Information

1. Summerfallow one year prior to planting.
2. Fence to protect against livestock.
3. Guard against fire damage.
4. Maintain clean cultivation both inside and outside of shelterbelt.

5. Never plant evergreens in same row as broadleaf trees.
6. Never prune shelterbelt trees except to remove dead or broken branches.
7. Always prepare a definite and complete plan of the tree planting program before the work is started.

Farmstead Shelterbelts — An ideal farm shelterbelt is made up of a snow trap of low-growing hedge material in the first row, fast growing deciduous trees in the second, slow growing deciduous trees in the third, and evergreens in the fourth. Two or more rows of each may be used if desired. Rows should be spaced wide enough so that farm power cultivators may be used. There should be 100 feet between buildings and shelterbelts.

As hedge material caragana, lilac, honeysuckle, buffalo berry, native fruits, sea buckthorn, hawthorn, dogwood and flowering currant (Potter strain). In low and wet locations, laurel willows should be planted.

Some fast growing, short-lived trees are male poplars, laurel leafed willows, Manitoba maple (not for Peace River or Foothills regions), Dropmore elm, and mayday. Slower growing, long-lived trees are green ash and American elm. Evergreens recommended are Colorado and white spruce, and Scotch and lodgepole pine.

FIELD and ROADSIDE WINDBREAKS

Field windbreaks, for wind erosion control, are planted in single rows 30 to 40 rods apart.

Roadside windbreaks should be 125 feet from the fence line. They act as permanent snow fences and reduce road clearing costs.

For sources of information and to obtain shelterbelt trees, apply to Department of Agriculture, Field Crops Branch, Edmonton, Alberta, or your District Agriculturist.

SMALL FRUITS

For information on growing strawberries, gooseberries, grapes, blueberries, cranberries, raspberries (red, black and purple), currants, and saskatoons, see sources of information and references.

VEGETABLES

General—Choose a level area not subject to late frosts. Where irrigation is not practical half the area should be summerfallowed the year previous to planting. An application of twelve to fifteen tons per acre of well rotted manure would be advantageous.

The Soil—Very light or heavy soils are to be avoided whenever possible. They may be modified by good garden practices, e.g. by plowing under granulated peat, well-rotted manure or green manure crops such as oats, rye or sweet clover.

Fertilizers—Fertility is maintained by the addition of well-rotted manures, vegetable refuse and straw (free of weeds), commercial fertilizers, and by conserving the fertility already present in the soil. For most Alberta gardens additional phosphorus should be added to supplement the small amounts that are present in animal manures. Superphosphate at 200 - 300 pounds per acre every two years should be ample, while a fertilizer such as ammonium phosphate 11-48-0 may replace the manure and superphosphate applications when applied at 100 to 200 pounds per acre every two years.

Soil Testing—Results of soil tests will be of considerable help in the better use of fertilizers. Information may be obtained from your District Agriculturists or from the Provincial Soil and Feed Testing Laboratory situated on the University Campus in Edmonton.

Crop succession—The length of growing season, the space required by mature plants, the location of the perennial vegetable beds, the possibility of using a succession of crops in any one season, all these are points to be considered in planning a garden. Rhubarb and asparagus may be completely separated from the main vegetable plot. Short season crops such as radish, lettuce, early cabbage, etc., may be grown quite close to vine crops (cucumbers, squash, etc.). Late cabbage, cauliflower and Swede turnips will require more room, and by careful planning a succession of crops such as radish, transplanted head lettuce and winter cabbage may be arranged.

Starting Plants Under Glass—Seeds are sown in plant pots or wooden boxes (flats), and the initial seedling growth may take place either in a sunny house window or in a greenhouse or hotbed. If manure is used for making the hotbed, it should be tramped in place at least two weeks before the bed is used. For seed treatment see section on plant diseases, page **64.**

Transplanting Seedlings — When the young plants are showing their first true leaves, they are ready for transplanting to other containers, and for this purpose, flats of a standard size (about 18" x 12" x 3½') are used. The plants are set 1½ x 1½ inches or 2 x 2 inches apart depending upon the type of plant, and the amount of hotbed space available. A mixture of two parts composted soil (garden loam with well-rotted manure) to one part of sand is excellent for growing transplanted plants.

Hardening Off—When frost danger lessens, the young plants are "hardened off" by gradually reducing the moisture, and by increasing direct exposure to both day and night temperatures. When transplanted to the field, place them as deep or a little deeper than they grew in the flats, and firm the soil about the roots.

Field Seeding—Sowing seeds directly in the garden, is usual with such vegetables as peas, beans, corn, late lettuce, carrots, etc. Seeds require optimum conditions of temperature and air before they will germinate. Arrange planting time to conform to these conditions.

Cultivation—This is most necessary and begins with thorough soil preparation before the seeds are planted, to ensure a uniform consistency of the topsoil. Cultivation after the garden is seeded, especially after rains and artificial watering, will control weeds.

Bulb Crops—Bulb crops include onions, leeks and garlic. Onions may be grown from seed sown early in the open ground, from plants started under glass, or from "sets" grown the previous year. The seed is drilled into rows 12 to 15 inches in the rows. Seed sown indoors in flats during late March produces plants that should be hardened off in mid-May. The plants should be root and top pruned lightly at transplanting time, and care be taken to set the plants shallow enough. Onion sets are set out in early May, usually earlier than seedlings may be transplanted. By late August or early September the onion tops should start to fall. At this time the bulbs are pulled and left in the field in windrows to dry for a week or ten days. Often protection against heavy dews and early frost must be provided.

Salad Crops and Greens—Lettuce, spinach, celery, Swiss chard, and kale are the most important of these crops. Lettuce is often seeded under glass and transplanted in early May. However, for later crops, seed may be planted out of doors as soon as the land can be worked. Place the rows 15 to 20 inches apart, and thin leaf lettuce to 4 to 6 inches in the row, and head lettuce to 8 inches. Succession planting will provide a supply over several weeks.

Spinach may be harvested for only a few weeks after sowing. New Zealand spinach, a mid-summer maturing plant, is sown in early spring and the plants thinned to 12 inches apart. Pick the individual leaves as required for greens. Swiss chard should be sown in the garden in early spring, and the plants thinned to 8 to 10 inches in the row. Celery, a tender long season crop, should be sown indoors in early March, and after a period in the hotbed and coldframe, transplanted to the garden in early June, at 6 to 8 inches apart in rows 36 inches apart.

Root Crops—Radishes are our shortest season crop, but except for the little known winter varieties, they do not keep long and grow to best advantage during the cool spring weather. All the root crops for winter storage require similar garden culture. All are seeded directly into the field, thinned to a suitable distance after germination, and kept free from weeds until harvest time.

Carrots and beets are thinned to 2 inches apart, parsnips to 3 and Swede turnips from 10 to 12 inches. Rows in general are 30 to 36 inches apart. Parsnips germinate slowly; they should be planted in early spring. For storage, plant carrots, beets, parsnips and turnips in early June. For continuous use, successive plantings of these vegetables may be made, beginning in very early spring.

Cole Crops—Most commonly grown are cabbage, cauliflower, broccoli and Brussels sprouts. Early varieties of cabbage, cauliflower and broccoli mature satisfactorily if sown out of doors in the early spring. By starting the plants indoors, an earlier crop can be harvested. To obtain tender white cauliflower, leaves should be tied or broken over the developing head.

Peas and Beans—(Peas and beans constitute one of the most widely grown vegetable groups.) Peas will stand considerable frost, but beans are very tender and if planted before frost danger is over, may have to be replanted. A succession of maturity with both beans and peas may be secured either by successive plantings or by planting early, medium and late varieties. Peas and beans are grown from seed planted directly out of doors, and spaced 1½ to 3 inches in the row, with rows 24 inches apart.

Vine Crops—In most districts of the province, squash, pumpkins and cucumbers usually succeed when sown directly out of doors May 20 to May 25. They may be started in the greenhouse or hotbed about the first of May, and transplanted to the garden early in June. To avoid disturbing the root system, two seeds are sown in bottomless paper cups filled with soil and closely set together in a wooden flat. The paper is carefully transplanted together with the young plants. Do not set the plant too deep. Hotcaps are often used for two weeks after transplanting when the outside temperature is cool.

Allow 8 x 8 feet for each hill of three plants of vine type squash and pumpkins. Bush type squash are planted at 4 x 6 feet. Cucumbers and muskmelons are set 3 x 6 feet if in hills, or 2 x 4 feet if single plants are used.

Tomatoes, Peppers and Eggplants — Tomatoes are started indoors, later being transplanted and moved from hotbed to coldframe and to the garden (in early June) when frost danger is past. Pruning of indeterminate varieties consists of pinching out all side branches, leaving only the blossom clusters and leaves attached to the main stem. The single stem is loosely tied with raffia to a sturdy stake. Unpruned plants require a space of 3 x 3 feet whereas

2 x 4 feet is ample for pruned plants. Many new varieties are self-pruning.

Eggplant seedlings are planted in the field at 2 x 3 feet and peppers 1 x 3 feet. Both should be transplanted in plant bands or with a good ball of soil on the roots, (and should not be checked by over-watering.) They prefer hot, dry conditions and a rather light loam soil.

Sweet Corn — Corn is seeded in drills 6 inches apart and thinned to 12 inches, or in hills (three plants in a hill every 36 inches) and the rows 36 inches apart. Seeding should be done about mid-May, and frequent but light cultivation given the crop. Since corn plants depend upon the wind for pollination, the garden plot should be of several short rows, side by side, rather than one long row.

Flowers — For information on growing annual, biennial and perennial flowers see the sources of information and references.

Lawns—For information on lawns see the sources of information and references.

NOTES ON OVERWINTERING

1. Begonia (Tuberous)

To keep the tubers over winter, dig them immediately after the first killing frost. Break the stems off closely, wash the tubers free of soil and let them dry a couple of days. After this drying period they should be stored in dry peat in a cool frost-free place (35 - 40° F). Either small polyethylene bags or shallow flats or trays are good as storage containers. After a rest period the tubers will be ready to start again the following March.

Heavy fertilizing and heavy watering should be discontinued a couple of weeks prior to harvesting the tubers. This will ensure mature tubers of good storing quality.

2. Dahlia — See Alberta Horticultural Guide.

3. Geranium — Plants to be saved should be dug prior to the first severe frost and planted in light soil or sand in flats, boxes, or pots. Moderate cutting back of top growth will facilitate handling and reduce the necessary storage space. They should be stored in a cool (approx. 40 degrees F.), dry dark place and watered only occasionally to prevent withering of the stems. The purpose is to keep the stems and roots alive but prevent any new growth.

In early or mid-January, the plants should be put in a warm well-lighted place and kept watered to encourage new growth. By late February, 2 to 3 inch cuttings may be taken from the more vigorous new growth, rooted in flats containing a mixture of sand and peat or sand and vermiculite and then potted in a soil mix. If these new plants are kept in full light, watered and fertilized, they should be well developed and ready to bloom by the end of May or early June.

An alternative method is to use the stored plants themselves for spring planting. In this method, as many plants as desired for next season should be saved and stored. At the time of storing, all plants should be severely cut back leaving only 3 to 4 inch stumps of the main branches. Otherwise storage procedures are the same as given above. In late January or early February the plants should be put in a warm, well-lighted place and kept watered and fertilized. By late May they should be well developed for transplanting outdoors.

4. Herbaceous Perennials

For most herbaceous perennials no special winter care is necessary. In fact for some, winter mulching appears to be more harmful than beneficial. In most cases a good covering of snow is the best protection. In districts where snow does not come early and stay through the winter, a mulch of straw may be placed over tender plants. In exposed positions, spruce boughs or other brush may be put on the border to help hold the snow. For those perennials which are recommended for Alberta conditions see the Alberta Horticultural Guide. For winter care of specific herbaceous perennials, see the list of references below.

5. Woody Ornamentals

Winter injury is generally less likely if there is plenty of moisture in the soil. Where water is available an application just before freeze-up is usually beneficial, particularly with shrubs planted under overhanging eaves. It is also important however that plants be hardened off to withstand the rigors of winter. This condition may be encouraged by reducing watering in early fall so that plants will become dormant. Shading the south side of a trunk with a board may also reduce the scalding effect of the winter sun. Generally wrapping with plastic has not proven satisfactory.

Many varieties of tender and half-hardy roses may be grown in Alberta if given special winter care.

For information on overwintering roses see the bulletin, "ROSE GROWING IN ALBERTA."

COMMERCIAL HORTICULTURE

The increasing interest in commercial production of horticultural crops in Alberta has resulted in publications now being made available concerning this particular field of Agriculture. Public meetings and short courses emphasizing commercial production are being conducted periodically. A number of grower organizations have been formed to assist in such problems as production, marketing, education and research. For further information on any of these aspects of commercial horticulture see the sources of information.

REFERENCES

1. Available from: Extension Service, Alberta Department of Agriculture, Legislative Building, Edmonton, Alberta.
   "Lawn Building & Maintenance" (Publication No. 2)
   "Farmstead Planning & Beautification" (Publication No. 9)
   "Judging Standards for Horticultural Shows" (Publication No. 19)
   "Alberta Horticultural Guide" (Publication No. 92)
   "Spring Flowering Bulbs" (Publication No. 109)
   "A Guide to Successful Tree Planting" (Publication No. 111)
   "Iris & Daylilies" (Publication No. 125)
   "Peonies" (Publication No. 128)
   "Forcing of Vegetables" (Publication No. 129)
   "Potatoes in Alberta" (Publication No. 137a)
   "Chemical Control of Insect Pests" (Publication No. 139)
   "Growing Chrysanthemums In Alberta" (Publication No. 147)
   "Gladiolus Culture" (Publication No. 163)
   "Growing Field Beans in Southern Alberta" (Publication No. 148)
2. Available from: Agricultural Secretary, Department of Extension, University of Alberta, Edmonton, Alberta.
   "Budding and Grafting" (Circular No. 29) Reprinted March, 1961.
   "Soils & Fertilizers for Alberta Gardens & Lawns" (Circular No. 30)
   "Chemical Control of Couch Grass" (Circular No. W-C-31)
   "Small Fruit Growing in Alberta" (Bulletin No. 54)
   "Woody Ornamentals for the Prairie Provinces" (Bulletin No. 58)
   "Alberta Horticultural Guide" (Publication No. 92)
   "Insecticides for Use Around the Home & Garden" (Leaflet No. 740)
   "Rose Growing in Alberta" (Bulletin H01)
   "The Prairie Garden' — 1962' (A compilation of articles by leading horticulturists of the Prairies — $1.00 per copy)
   "Leaflet Series H-O-1" (A Series of Eight Colored Plates of Trees and Shrubs, Suitable to Alberta Conditions — 50c per set)
3. Available from: Information Service, Canada Department of Agriculture, Ottawa, Canada.
   "Planning Your Garden" (Circular No. 795)
   "Annual Flowers for Canadian Gardens" (Publication No. 796)
   "Manures and Compost" (Publication No. 868)
   "Garden Rose Growing" (Publication No. 908)
   "Planning Farm Home Grounds" (Publication No. 959)
   "Descriptive Notes on Herbaceous Perennials for Canadian Gardens" (Publication No. 968)
   "Growing Herbaceous Perennials" (Publication No. 970)
   "Windbreaks for the Peace River Region" (Publication No. 973)
   "Culture of Ornamental Trees for Canadian Gardens" (Publication No. 994)
   "Trees for Ornamental Planting" (Publication No. 995)
   "Flowering Bulbs for Canadian Gardens" (Publication No. 996)
   "Ornamental Shrubs for Canadian Gardens" (Publication No. 1011)
   "Woody Climbers and Ground Covers for Canadian Gardens" (Publication No. 1017)
   "Home Vegetable Growing" (Publication No. 1059).
   "The Construction & Care of Lawns" (Publication No. 1065)
   "Vegetable Gardening Practices" (Publication No. 1070)
   "Handbook for Northern Gardeners" (Publication No. 1081)
   "The Prairie Home Orchard" (Publication No. 901) (Obtainable only from the Queen's Printer — Price 25c)
   "Living With House Plants" (Publication No. 1016) (Obtainable only from the Queen's Printer — Price $1.00)

"SPECIAL NOTE" — PROPER VARIETIES AND GOOD STOCK are most important for successful gardening in Alberta. Be sure you know the varieties adaptable to your area; these varieties are listed in the "ALBERTA HORTICULTURAL GUIDE."

SOURCES OF INFORMATION

1. Your local District Agriculturist.
2. The Provincial Department of Agriculture, Edmonton.
3. The Provincial Horticultural Station, Brooks, Alberta.
4. The University of Alberta, Edmonton, Alberta.
5. The Canada Department of Agriculture, Research Stations at:

   Lethbridge
   Lacombe
   Beaverlodge
   Fort Vermilion

Plant Diseases

Diseases of plants do not just happen; they are always the result of a cause. The causes are divided into two broad groups; parasitic (infectious) and non-parasitic (non-infectious). Man and animals are not the only kinds of life that depend on green plants for their existence. Microscopic organisms such as bacteria, fungi, nematodes and viruses may invade and grow within or on plant tissue and obtain their nourishment from it. They cause parasitic diseases. Non-parasitic diseases are due to environmental or nutritional factors unfavorable to the plant. Since an organism is not involved they cannot be spread and are, therefore, non-infectious.

Parasitic microorganisms may interfere with the functioning of the infected plant by one or a combination of the following means: rob the plant's food; introduce toxins or other harmful materials into the plant's system; or plug the water- or food-conducting vessels. These actions result in certain visible effects or symptoms. Some of the more common symptoms produced by parasitic or non-parasitic diseases are:

spots, wilts, blights, rots, cankers, rusts, stunting, galls and various discolorations and malformations of plant parts.

Usually symptoms are characteristic of a specific disease and this helps us to recognize the cause of that disease. However, somewhat similar symptoms may be caused by entirely different agents. Proper diagnosis of the disease is, therefore, important because, depending on the cause, entirely different methods of control may be required.

Although many parasitic microorganisms can attack a great number of different kinds of plants, most of them are limited to a narrow range — sometimes only to one species or to a few varieties of the species. On anything else they cannot grow — these plants are said to be resistant to the organism. Plants which are freely attacked by an organism are called susceptible. Degrees of resistance or susceptibility exist and these characteristics can be transferred by plant breeders into desirable plants.

Under cultivation, numerous individuals of one kind of plant grow near each other over a wide area. This situation increases the chances for infection and the opportunities for spread of the infectious organism. The microorganisms may be spread by winds, splashing rain, insects, or tillage operations, and an epidemic can occur if the disease is spread rapidly over a wide area. Correct diagnosis of the disease and timely control measures are, therefore, essential for the prevention of destructive diseases of plants.

The following information is intended to acquaint you with the symptoms, causes and control measures for the more common diseases of cultivated plants in Alberta.

USE DISEASE FREE SEED AND PLANTING STOCK

The fungi, bacteria and viruses that cause most plant diseases may be carried in or on the surface of the seed or planting stock, in the soil, in diseased tissues or in crop refuse. Weeds and other "wild" plants may also harbour them. Insects may also act as carriers. Control measures are based on these facts. See the table on pages 67-78.

Resistant varieties are being produced and should be used if recommended for your area (see Varieties of Grain for Alberta and The Alberta Horticultural Guide).

Since many diseases are carried by seed and other propagating stock it is good practice to start with reliable planting material. This is especially true for those diseases carried within the seed or planting stock and therefore not controlled by chemical treatments. Examples are loose smut of barley and wheat, halo blight of beans, angular leaf spot of cucumber, leaf roll of potatoes, mosaic of raspberies, certain viruses of plum and bacterial ring rot of potatoes. Certified seed or planting stock should be used because of its greater freedom from these plant pathogens.

SEED TREATMENT

Seed treatment not only controls certain seed-borne diseases but it also protects seed from soil-borne microorganisms. Consequently high-quality seed may benefit from seed treatment but seed that has been injured will benefit even more. Some seed treatment preparations also contain an insecticide for wireworm control.

Although fungicides are used mainly, disease control may be effected in some instances by heat or simply by soaking the seed in salt water. Different treatments may be needed for different diseases, but some have rather wide application. The organic mercurials are generally recommended for grain. Non-mercurial organic fungicides are used extensively in vegetable seed treatment and some of them are effective for some grain diseases as well. Choice of products will depend on the seed to be treated, the disease for which protection is desired, preference for a liquid, slurry, or dust form of application, and cost per unit of seed treated. An appraisal list of fungicides on sale in Canada for the treatment of grain crops may be obtained from your District Agriculturist. This list gives an estimate of effectiveness.

Choose the fungicide on the basis of effectiveness in disease control and freedom from undesirable qualities. Formaldehyde (formalin) should not be used because it is injurious to seed even though it is a good fungicide. If an individual is allergic to a certain fungicide a substitute can usually be found.

WARNING

Most seed treatment chemicals are toxic to humans. Follow the directions on the container for dosage rates for the particular crop and read and heed the handling precautions stated on the label.

Cereals—Cereals are subject to numerous seed-borne diseases. The surface-borne smuts (e.g., bunt of wheat, covered smut, and false loose smut of barley) can be controlled by treating the seed with a fungicide. The true loose smuts of barley and wheat are not controlled by fungicide treatments because the fungi are inside the seed. Proper seed treatment will also protect the seed from other seed-borne and soil-borne microorganisms especially if the seed has been damaged. Therefore, it is generally better to treat than not to treat. Treatments for loose smut and for wireworm control should be employed only when they are known to be present.

Oilseeds — Flax benefits greatly from

proper seed treatment, yet much untreated flax is sown. Treated flax is protected from soil-borne microorganisms and for this purpose alone seed treatment is advisable. Seed treatment will also help to control diseases that are seed-borne. Because flax seeds are smaller than those of the cereals more fungicide is required to give adequate coverage.

Seed treatment of safflower and sunflower is recommended but rape and mustard do not generally benefit from it.

Forage Legumes and Grasses — Seeds of forage legumes and grasses are seldom treated. While in special cases seed treatment may be beneficial, no general recommendations for these crops can be made.

Vegetables — Treatment of vegetable seeds such as peas, beans, and corn is recommended for protection from seed rot and damping-off. Potato seed-pieces should be treated to protect them for seed-piece rot. Non-mercurial organic fungicides are generally recommended.

PROTECTION OF PLANTS BY SPRAYING OR DUSTING

Fungicides applied as sprays or dusts are useful in protecting plants from many diseases. Insecticides are used to control insects that transmit certain plant diseases.

Treatments should be made when the air is still. The dust or spray should be forced through the foliage to insure that all parts of the plant are protected.

The first application should be made as soon as symptoms appear or sooner if experience of previous seasons indicates this. Subsequent applications should be made as often as warranted; moist weather favors the spread of most pathogens and also washes off the protective coatings.

Handle chemicals with caution; follow the manufacturers directions precisely.

HERBICIDE INJURY

2,4-D is a major cause of damage to crop plants. The chemical is a growth hormone that kills weeds by forcing them into excessive rapid uncontrolled growth. It has a similar effect on other plants. Damage to cereals is usually seen as swelling of the two lower nodes and splitting of the stem near the soil surface. Injury to leaves has been noted on trees, shrubs, ornamentals, fruits, and vegetables. Leaves may show cupping, stringiness, or brown dead areas at the edges. These injuries are associated with abnormally prominent veins that tend to run parallel rather than fan-like. The leaves are also thicker, more brittle, and darker green than normal.

The fumes of 2,4-D, especially the ester, often drift with the wind for a considerable distance. Never use 2,4-D when the wind is blowing from the treated area towards susceptible plants.

CULTURAL PRACTICES

Seeding Precautions — Growing conditions are very important in preventing damping-off of seedlings. The soil should have sufficient moisture before seeding to carry the plants through this critical stage. Irrigated land should be fall-irrigated to ensure a good moisture supply at planting time. To avoid serious stand reductions by damping-off in crops such as wheat, alfalfa, sugar beets, and peas, they should be planted in cool soil while others such as corn, beans, and cucumbers should be planted after the soil has warmed. Early sown cereals often escape the most serious effects of rust and yellow dwarf virus.

Trash Cover — In recent years leaf diseases and root rots have taken an increasing toll of cereal crops. Among the factors that have contributed to this, the use of trash cover is possibly the most important. The combine also aggravates the situation by increasing the amount of straw.

Leaf-inhabiting fungi and bacteria survive on straw and leaf fragments. They pass the seasons between crops in a dormant state. In warm, moist weather the fungi produce spores and the bacteria multiply rapidly. Shallow cultivation leaves the plant debris on or near the surface of the ground where the pathogens may easily infect the next crop.

These organisms were formerly controlled by burning the straw or ploughing it under. Because of soil erosion, plant disease control must now be based on the maintenance of trash cover. Control of leaf and root diseases must depend more than ever on crop rotation. Most leaf diseases are specific to one crop but root attacking microorganisms will often attack several crops. A diseased crop of wheat can be followed safely by a non-cereal crop or oats. Wheat should be followed by barley only if root rot has not been a problem. Potatoes should be followed by cereals, peas, or crucifers but not by tomatoes or alfalfa. When a resistant crop is used in a rotation the carryover of the disease organism on crop refuse will be reduced. Summerfallowing the land is usually as effective as planting a non-susceptible crop.

Leaf and root diseases are reduced by ploughing. Where trash cover is required to protect the soil from drifting the ploughing should be done immediately prior to seeding.

General Cleanliness — Sprays and dusts are useful but are not cure-alls. They should go hand in hand with sound practices designed to eradicate or reduce the sources of infection. With virus diseases or with diseases affecting the woody parts of trees, it is better to remove and destroy the whole plant or prune out the affected part rather than to wait for the plant to recover. It will not. The lossincurred from rogu-

ing and pruning plants will usually be offset by reduced spread of disease to nearby healthy plants.

General cleanliness is always helpful. Prunings and other plant debris should be immediately buried or burned. Weed control is also important as weeds harbour diseases that affect crops.

ADDITIONAL INFORMATION

This section provides only general information on the identification and control of the most important diseases occurring in Alberta. Additional information may be obtained through your District Agriculturist (see list and location on page **176.** The following publications are also sources of useful information on plant disease problems:

Diseases of Field Crops in the Prairie Provinces, Canada Deport of Agriculture.

Varieties of Grain for Alberta, Extension Service, Provincial Department of Agriculture.

The Alberta Horticultural Guide, Extension Service, Provincial Department of Agriculture.

An Appraisal of Some Seed Treatment Products for Sale in Canada available from your District Agriculturist.

IMPORTANT

In the following table trade names of products are used as examples only.

Warning

Most seed treatment chemicals are toxic to humans. Follow the directions on the container for dosage rates for the particular crop, and read and heed the handling precautions stated on the label.

Disease	Crop	Symptoms	Control
KERNEL AND HEAD DISEASES			
Bunt (covered or stinking smut)	Wheat	Balls of black spores in place of kernels. In threshed grain, spores from broken balls blacken brush ends of kernels. Unpleasant odor.	Treat seed with suitable fungicide* according to manufacturers' instructions. Use resistant varieties where recommended.*
Covered smut	Barley	Kernels become masses of purple-black spores in thin membranes which do not rupture until threshing. Clumps of smut spores are conspicuous in threshed grain.	Treat seed with a suitable fungicide.* Because of the hulls on oats and barley some fungicides are not effective, even though suitable for wheat. Treatment a week or more in advance of seeding is required with some fungicides. Follow directions on the label. Use resistant varieties if recommended for your area.*
False loose smut	Barley	Spikelets replaced by loose, powdery smut masses which are blown away by wind. Smutted heads resemble those caused by true loose smut except that the latter are lighter in color.	
Covered and loose smut	Oats	Dark brown spore masses replace spikelets. May be of covered or loose type or intermediate.	
Stalk smut	Rye	Dark spore masses as stripes on stems and leaves as well as in the heads.	Treat seed as for bunt of wheat.
Head smut	Cultivated grasses	Spikelets become powdery masses of black spores. Plants once infected produce smutted heads every year.	Treat seed with non-mercuric fungicide such as Arasan or Orthocide. Rogue out infected plants.
Loose smut	Wheat Barley	Dusty black spores replace the kernels and are soon blown away by wind, leaving the head bare. Not evident in threshed grain.	Use registered or certified seed. For barley, treat enough for seed plot as follows: Place about 2 bus. seed in tub or barrel. Add enough 1% salt water (1 lb. salt to 10 gals. water) to keep grain covered for treatment period. Raise water and seed temperature to 70-75° F. and hold temperature for 65 hours. Drain and spread to dry quickly to prevent sprouting. Seed in plot isolated from other barley. Use crop for main planting next year.

* See introduction to Plant Diseases section for further information.

Disease	Crop	Symptoms	Control
Ergot	Grasses Rye Barley Wheat Oats	Conspicuous hornlike purple to black fungus bodies in place of seeds; present in threshed grain. Poisonous to man and animals.	Cut all nearby grasses before they head. Clean ergot from seed. If a few ergot bodies remain, sow the seed at least two inches deep. Plow deeply after harvesting an infected crop to bury ergot bodies on the field. Grass hay should be cut before flowering.
Smudge (black point)	Wheat Barley	Dark brown discoloration, especially prominent on germ end of seed.	Remove lighter seed with fanning mill. Treat seed with a mercurial fungicide.
Blast	Oats	White empty spikelets, usually at the base.	Cause unknown.
FOLIAGE AND STEM DISEASES			
Stem rust	Wheat Oats Barley Rye Grasses	Dusty, raised, reddish brown oblong spots on leaves, stems and heads, becoming black as the plants mature.	Use resistant varieties where recommended*. Early seeded crops and early varieties tend to escape rust.
Leaf rust	Wheat Barley Rye	Dusty, yellow to light orange, small round to oval spots on leaves and sheaths, becoming black as the plant matures.	As for stem rust.
Scald	Barley Rye Some grasses	Oval — or lens-shaped spots at first grey-green. Later dry to pale or white center surrounded by brown margin.	Include non-susceptible crops in rotation and turn under crop residue where feasible. Treat seed with fungicide as directed on label.
Spot blotch	Barley Wheat Rye	Dark brown oblong to round spots that later fuse to form blotches.	As for scald.
Net blotch	Barley	Brown elongate areas showing a network of darker brown lines. Netted areas enlarge and fuse.	As for scald.

* See introduction to Plant Diseases section for further information.

Disease	Crop	Symptoms	Control
Septoria leaf and glume blotch	Wheat Barley	Light brown blotches on leaves and glumes that become speckled with black dots. Mature straw is dirty grey.	As for scald.
Bacterial blight	Barley	Narrow, glossy-surfaced stripes on leaves, at first water soaked, changing to dark brown and finally translucent. Affected areas produce droplets of sticky ooze.	As for scald.
Halo blight	Oats	Pale yellowish-green oval spots with small dead sunken centers.	Seed treatment, sanitation and rotation reduce the general abundance of the disease*.
Wheat streak mosaic	Winter and spring wheat Barley	Light green to yellow streaks on leaves. Plants may be severely stunted.	Avoid fall-infection of winter wheat by destroying volunteer growth in the same or adjacent fields at least a week before seeding. Seed September 1 - 15 in south Alberta. Do not plant spring wheat adjacent to diseased winter wheat.
False stripe	Barley	Leaves have yellow stripes that turn to dark brown, and usually terminate in a V-shape.	Virus carried in seed, therefore avoid seed from infected crop.
Leaf banding	Cereal seedlings	One or more narrow white bands on seedling leaves or sheaths. Often causing break over at this point. Caused by either high or low (freezing) surface soil temperatures.	Trash cover gives some protection. Seedlings normally recover.
Yellow dwarf	Barley Wheat Oats	Leaves of barley and wheat turn golden yellow from tips downward, principally along margins. Oats similarly turn various shades of red. Severe stunting results from seedling infection.	Severe damage by this aphid-carried virus is best avoided by early seeding.
Grey speck	Oats Barley Wheat	Numerous white-brown dead areas cause otherwise green leaves to break over. Most commonly found in oats growing on black soils of foothill region.	Where encountered avoid highly susceptible oat varieties — Eagle, Garry, and Rodney, and use the more tolerant varieties Glen, Abegweit, and Larain. Wheat and barley are more tolerant than most oat varieties.

* See introduction to Plant Diseases section for further information.

Disease	Crop	Symptoms	Control
Powdery mildew	Cereals Grasses	White powdery growth, especially on lower leaves. May be spotted with minute black dots.	Seldom serious except occasionally on irrigated land. Valuable plots may be dusted with sulphur.
Snow mould	Grass crops Lawns Golf greens Winter cereals	Conspicuous white fungus growth overrunning leaves and crown tissues, causing dead patches in crop or turf. Occurs in spring frequently under or near melting snow.	Crop sanitation and rotation may help for cultivated grasses and winter cereals.* For lawns and golf greens a fall application of equal parts of calomel and corrosive sublimate at the rate of 4 oz. per 1000 sq. ft. is recommended. This mixture should be applied with enough dry sand to assure even distribution.
Cold and winter injury	Grasses	Plants dead in spring, usually in patches. Crown and roots decayed.	Use hardy varieties. Avoid late fall cutting, over-grazing, and burning.
ROOT DISEASES			
Common root rot	Wheat Oats Barley Rye Grasses	Plants stunted and generally lacking in vigor. Brown discoloration of stem bases, roots, crown, and lower leaf sheath. Increases in severity after successive susceptible crops.	Rotate non-susceptible crops such as flax, legumes, or rape with cereals. A two-year period without susceptible crops will reduce the level of infection. Oats are less susceptible than wheat and barley and are beneficial in the cereal rotation. Where conditions permit, the mold-board plow may be used to bury contaminated surface soil and trash, preferably just before seeding. Treat seed with mercury fungicides.
Seedling blight	Cereals	Seed rotting and death of seedling before or shortly after they emerge cause thin stands.	Treat seed with a mercury fungicides.
Take-all root rot	Wheat Barley Grasses	Occurs in scattered plants or in patches in the black and dark brown soils. Plants stunted and bleached. White heads with no kernels. Roots shiny black and brittle. Plants easily pulled.	After breaking sod use rotation wheat, oats, wheat, fallow, followed by long term rotation. Maintain soil fertility. Take-all may become troublesome if wheat follows wheat.
Browning root rot	Wheat Oats Barley Millet Grasses	Large areas of seedling crops appear brown. Lower leaves extensively browned and dead. Seedlings are stunted, maturity delayed and yields lowered. Occurs most commonly in the crop following summerfallow.	Use phosphate fertilizers. Maintain soil fertility. Sow in a firm seed bed. Work in combine stubble. Grasses sown in June may be severely injured.

* See introduction to Plant Diseases section for further information.

Crop	Disease	Symptoms	Control
Flax	Browning or Stem Break	Most conspicuous after flowering as brownish blotches on stems, leaves, and seed capsules. Some plants may break over just above the soil surface.	Avoid sowing flax after flax and leaving stubble exposed near new flax. Use clean seed. Treat seed.
	Rust	Small reddish powdery pustules mainly on the leaves in midsummer and smooth black blotches chiefly on the stems later in season.	Follow above measures and use a rust-immune variety if one suited to your district is available.
	Seed Rot and Seedling Blight	Poor emergence due to seed decay in the soil. Some seedlings wilt and die.	Treat seed.* A shallow, firm seed bed results in less damage.
	Pasmo	Symptoms similar to those of browning. Develops later in season, and plants do not break over.	As for browning or stem break.
	Wilt	Plants may wilt wholly or partially at any stage. Tips of plants bend downwards.	Most of the newer varieties are wilt-resistant and should be grown. Avoid late seeding and continuous cropping to flax.
	Yellows	Leaves yellowish, bunched at top, and flowers greenish and deformed. Seed capsules fail to develop.	Eradicate weeds near flax fields to reduce visitation of insect carrier (a tiny leafhopper).
	Heat Canker	Plants girdled at ground line. Often fall over.	Early and heavy seeding.
Mustard Rape	White rust	Small, raised white areas on the stems and leaves. Infected flower parts are enlarged and distorted.	Use clean seed. Rotate crops.*
Mustard Rape	Downy mildew	Yellow lesions with downy mold on the leaves. Large, brown irregular-shaped growths in place of some normal seed pods.	Clean seed. Rotato crops.*
Mustard Rape Sugar beets	Seedling blight	Seedlings wilt and die.	A shallow, firm seed bed will result in less damage.

* See introduction to Plant Diseases section for further information.

Crop	Disease	Symptoms	Control
Rape Sunflower	Wilt and basal rot	Leaves wilt, decay, and cankers form at base of the stem. Hard, black fungus bodies may occur in or on diseased tissues. Heads and seeds may be affected occasionally.	Rotate with cereal and grass crops. Use clean seed.
Safflower	Rust	Red rust appears in small tufts on the leaves and stems. Infection often girdles seedlings at ground level causing them to wilt and break off.	Rotate crops. Avoid seeding safflower adjacent to infected safflower stubble. Treat seed.*
	Leaf spot	Irregular, brown spots on the lower leaves and when severe on the outer flower parts.	Rotate crops and treat seed.*
	Root rot	Plants wilt and die.	Use a resistant variety. Rotate crops and treat seed.*
Sugar beets	Black root	Brown and black discoloration of stem and roots of seedling.	Maintain soil fertility, rotate crops, and treat seed.
	Leaf spot	Leaves have light brown spots with poorly defined margins. Speckling may occur within the spots.	Rotate crops and treat seed.
Sunflower	Rust	Rust-colored spots appear on leaves and sometimes on the stems and lower surface of the head. As the plant matures the spots on the stems turn black.	Rotate crops.*
	Downy mildew	Yellow spots with downy mold on the leaves. Severe stunting of plants and seeds are empty.	Rotation should not include sunflowers oftener than once in three or four years.
	Leaf mottle	The tissues between the veins of affected leaves become pale green, then yellow and finally die and turn brown.	Rotate crops.*
	Stalk rot	Brown or black blotches that extend from the stem on to the leaf stalks.	No control.

* See introduction to Plant Diseases section for further information.

DISEASES OF FORAGE LEGUMES

Crop	Disease	Symptoms	Control
Alfalfa	Crown bud rot	Decay or rot of crown buds during growing season. The disease is favored by conditions that promote rapid growth.	Avoid late cutting and excessive grazing of alfalfa land. Use wide crop rotation.
	Winter crown rot	Patches of plants are killed out in early spring. The fungus can sometimes be seen covering the plants after the snow has melted.	Plant winter hardy varieties and avoid late cutting and grazing of alfalfa land.
	Winter injury	Dead plants occur singly or in patches especially under ice or in gateways under excessive trampling. Plant crowns and upper portions of roots are shredded.	Plant winter hardy varieties. Avoid excessive grazing.
	Bacterial wilt	Plants are reduced in vigor, are stunted, and may have tiny yellowish leaves. Heavily diseased plants have a brown ring in the interior of the root.	Plant a resistant variety of alfalfa sufficiently winter hardy for the area. Recommended varieties of alfalfa are given on page 48. (See forage crop section.)
	Black stem	Small, black or dark brown spots on the leaves, stems, and seed pods. Heavily infected plants may drop their leaves and seed pods.	Early spring burning of stubble and crop debris before new growth begins. Make the first cutting of hay as early as possible.
	Common leaf spot	Circular brown spots on the leaves. These spots later develop raised centers. Heavily infected leaves may drop off.	Cut the hay crop early enough to catch the leaves before they fall.
	Seedling blight	Rotting of the seed, death of seedlings before or shortly after they emerge, resulting in thin stands.	Treat clean seed with non-mercurial fungicides such as Arasan or Captan. If treated seed is to be inoculated, do it just before seeding to avoid damage to the nodule-forming bacteria.
Alfalfa	Witches' broom	Small, yellowish leaves with dried edges borne in unusually large numbers of fine stems giving a "broom-like" appearance to the plant.	Strive to maintain healthy thick stand of alfalfa. The disease is spread by an insect that does not like shady moist conditions.
Red clover	Northern anthracnose	Brown, sunken areas on stems, cracking of the stems, girdling of petioles and wilting of flowers, resulting in a reduced seed yield.	Crop rotation.

Plant	Disease	Symptoms	Control
Red clover	Powdery mildew	Light gray powdery growth on upper surface of the leaves. Leaves turn yellow and eventually brown where mold infection is sufficiently severe.	No economical control measures are available.
Alsike clover	Sooty blotch	Prevalent in low, wet areas. Dark brown or black blotches on the lower surface of leaves. Later in the season, infected leaves wither when the blotches are numerous.	No economical control measures are available.
VEGETABLES			
Beans	Halo blight	Small water-soaked spots on the leaves develop into brown, dead areas of varying size and shape, often bounded by a yellow margin or halo. Brownish-red, dry, sunken lesions appear on the pods.	Do not sow discolored seeds or those from spotted pods. Use guaranteed "blight-free" seed. Do not work around plants when foliage is wet. Burn diseased crop refuse and rotate crops.
	Anthracnose	Dark brown lesions on all above-ground parts. The most striking symptom is the formation of large, deep, dark-colored cankers on immature pods.	Follow recommendations for halo blight.
	Mosaic	Mottling (light and dark green) and puckering of leaves, stunted plants; blossoms tend to drop and pods are shorter than normal.	Grow mosaic-resistant varieties such as Contender, Tender-long No. 15 Top-crop, Puregold Wax, Kentucky Wonder, and Blue Lake.
Beets	Seed rot and damping-off	Poor seedling stand, seedlings collapse and die.	Treat seed with Captan or Thiram. Avoid excessive moisture.
	Leaf spot	Numerous small spots with light tan or grey centers and dark brown borders.	Treat seed with a fungicide.* Spray or dust with a copper fungicide only if the disease is severe. Rotate crops and clean up and burn refuse.
Cabbage and related plants	Damping-off	Poor stand, seedlings collapse.	Treat seed with a fungicide.* Maintain an even moisture supply.
	Black rot	Leaves turn yellow, then black in V-shaped areas from margins inward, blackened veins.	Use disease-free seed or soak seed in water maintained at 122° F. for 30 minutes, dip in cold water, dry thoroughly. Practice crop rotation in field and seedbed.
Carrots	Yellows	Yellowing of young leaves, reddening and twisting of older leaves. Small, hairy and poor quality roots.	Damage may be reduced by controlling weeds and the leafhoppers that are carriers of this disease (see insect section).
Celery	Late blight	Small, yellow spots on older leaves and stalks turn dark grey-brown and become covered with tiny black specks.	Spray with 8-8-100 Bordeaux mixture or use a copper-lime dust at weekly intervals. Remove and destroy plant debris in fall.

Crop	Disease	Symptoms	Control
Corn	Seed rot	Poor stands.	Treat seed. Do not sow in cool soil.
	Smut	Large,whitish-colored, tumerous growths on stalks, ears, or tassels that burst and release a black, powdery mass of spores.	Remove and destroy affected plants.
Cucumber	Angular leaf spot	Small, water-soaked spots on leaves, stems, and fruits. On leaves these spots develop into tan, angular spots that are gummy or shiny on the under-surface. Spots on stems and fruits covered with a white exudate. Fruits may rot.	Destroy plant debris. Plant disease-free seed. Rotato crops. Do not harvest when plants are wet.
	Bacterial wilt	Leaves and vines wilt and die. A sticky ooze is found when wilted stems are cut.	Remove and destroy wilted plants as soon as found.
Lettuce	Sclerotinia rot or drop	Progressive wilting and rotting beginning with outer leaves. Whole plant collapses and rots.	Remove and burn plants as soon as symptoms appear. Rotate with non-susceptible crops such as corn or potatoes.
Onion	Neck rot	Rotting of stored bulbs, usually at the neck. Gray fungus growth containing small, black bodies often evident.	Cure thoroughly and store at slightly above 32° F. with good ventilation. Colored varieties are more resistant than white ones.
Peas	Seed rot	Poor seedling stand.	Treat seed with Captan. Plant in cool soil.
	Leaf and pod spot	Circular or irregular tan or purplish-brown spots with darker margins on leaves, pods, and base of stems. The spots on the pods are sunken.	Burn diseased vines after harvest. Use disease-free seed.
	Mildew	White, fluffy, or powdery growth on leaves, stems, and pods; later dotted with dark specks.	Dust or spray plants with sulfur.
	Root rots and wilt	Base of stem rotted, plants yellowish, wilted or both.	Follow a 4-year rotation and avoid excess moisture.
	Bacterial blight	Small, glistening, brown spots on leaves. Larger water-soaked spots on pods and stems.	Rotate with other crops. Use disease-free seed.
	Leaf blotch	Indefinite areas turn pale or yellow and spread to cover the whole leaf. Numerous pin-point, black spots appear on the lower leaves and stem.	Rotation is the main control measure.
Potato	Early blight	Small, irregularly-shaped, dark brown spots on leaves with target-like markings.	Plant certified seed. Spray with Bordeaux 10-10-100 or Dithane at first appearance of disease and at 10-day intervals.

Crop	Disease	Symptoms	Control
Potato	Late blight	Irregular-shaped, rapidly enlarging, dark-brown areas on leaves surrounded by a water-soaked border. Infected tubers first show a purple discoloration of the skin that later develops into a brownish dry rot either in the hill or during storage.	As for early blight. Do not store diseased tubers.
	Bacterial ring rot	Yellowing, rolling, and death of leaves. Plant wilts. When cut open, tubers and stems show an internal brown ring.	Plant certified seed. If cutting seed tubers disinfect knife after each cut with mercuric chloride (1 part to 500 parts water). Disinfect all machinery and storage facilities. Notify your District Agriculturist.
	Leaf roll and mosaic	Mottling, rolling, and yellowing of leaves. Stunted plants.	Plant certified seed. Dig and destroy diseased plants. Control insect carriers (aphids and leafhoppers).
	Scab	Rough, corky brown scabs on tubers.	Plant certified seed. Rotate with legumes or grains.
	Rhizoctonia	Brown cankerous areas at base of stems. Tops may show rolling and reddening of upper leaves and aerial tubers may form in leaf crotches. Tubers often have specks of black "dirt" that is not easily washed off.	Plant certified seed. Rotate with grains.
Potato	Black leg	Base of stem black and shrivelled. Branches rigid and upright and leaves pale. Tubers rot starting at stem end. In storage the rot spreads, creating a vile odor.	Plant certified seed. Seed pieces should be planted as soon as cut or kept in cool, well-ventilated storage. Destroy potato refuse after harvesting. Rotate crops.
Tomato	Early and late blight	Leaf symptoms are the same as for potato. Fruit has dark, leathery decayed spots.	Spray with a fixed copper or other fungicide such as nabam at 7-10 day intervals.
	Leaf spot	Small spots on leaves with grey-brown centers and dark margins. Dark specks in centers of spot.	Destroy vines in fall. Rotate crops.
	Blossom-end rot	Large, sunken leathery rot occurring only at the blossom end of fruit. This condition is usually caused by the soil drying quickly when plants are growing vigorously.	Maintain an even moisture supply.
	Wilt	Leaves dull green, plants stunted. Inner tissue of stem has brownish discoloration.	Rotate with cereals. Do not plant tomatoes on land that may be infested.

Plant	Disease	Symptoms	Control
SMALL FRUITS			
Strawberry	Leaf spot	Reddish-purple spots on leaves later turn gray with a purple border.	Spray with Captan in the middle of May and again in early June.
	Powdery mildew	Leaves curl upwards and a white powdery growth occurs on the under surface.	Dust undersides of leaves with sulphur when the buds are unfolding and at 12-day intervals for next 5 weeks.
	Yellow-edge	Central leaves dwarfed and "cupped" with yellow edges. Outer leaves more or less normal. Fruit is small.	Remove and burn all infected plants and their runners as soon as the symptom appears. Obtain virus-free stock.
	Red stele	Leaves small and bluish with short stems. Little or no fruit produced. Roots long and stringy and have a characteristic dark red core.	Destroy diseased plants and runners. Plant disease-free stock in new location.
Raspberry	Mosaic	Leaves on new canes and/or on laterals of fruiting canes are at first light green, then become mottled with yellow and tend to pucker.	Rogue out and burn diseased and adjacent plants. If extensive, destroy entire plantation. New plantation should not be within 100 yards of old location and certified virus-free stocks should be used.
	Leaf curl	Leaves wrinkled, curled, and darker green than normal.	Follow control for mosaic.
	Crown gall	Plant stunted. Knobby swellings on roots.	Destroy infected plants. Plant disease-free stock in new location.
	Spur blight	Dark red or chocolate-brown spots on leaf stalks and young bark. Fruit spurs weak, chlorotic and seldom bloom.	In fall, prune out and burn all old canes and any diseased young canes. Spray with Bordeaux 3-6-40 when young canes are 8-10 inches high.
Currants Gooseberry	Powdery mildew	White, flour-like coating on young leaves and fruit, becoming light-brown and felt-like.	Spray when the leaves begin to emerge and twice more at 12-day intervals with Captan or wettable sulphur. Grow recommended resistant varieties.

Plant	Disease	Symptoms	Control
TREE FRUITS			
Apple Crabapple Pear Mountain Ash	Fireblight	Blossoms and leafy shoots suddenly wilt, turn brownish-black, shrivel and die as if scorched by fire, but remain on the tree. Later, cankerous areas of shrunken and discolored bark may appear on branches at the base of affected shoots.	Use resistant varieties. Diseased wood should be removed as soon as it appears, cutting about 6 inches below the discolored area. Wash pruning knife and cut surfaces with a solution of 1 part mercuric chloride to 500 parts of water after each cut. Burn the diseased wood.
Apple	Apple scab	Dark, green, velvety spots on leaves and fruits. On the fruit these develop into dark brown scabs.	Spray with lime-sulphur, Bordeaux mixture, or Ferbam in spring and early summer. Burn leaves in fall.
Plum Cherry	Brown rot	Blossoms turn brown prematurely. Watery, brown spots enlarge and rapidly envelop the fruits and later become covered with greyish powder. Fruit dies and shrivels.	Lime suphur, wettable sulphur, Phygon, Captan, or Ferbam sprays at blossom and early fruit stage will check the spread of rot. Cut out and burn any diseased twigs. Burn all rotten or mummified fruits.
Cherry Plum	Black knot	Velvety, olive green thickenings appear along the twigs in the spring and by fall develop into conspicuous black, hard, and rough-textured knots.	Cut out and burn infected wood 3-4 inches beyond the knot. Spray with lime-sulphur or other fungicide when leaf buds start to open.
Plum Cherry	Shot hole or leaf spot	Small red or brown spots on leaves. The centers of these spots drop out giving a "shot hole" effect.	Spray trees with lime-sulphur (1) in late April, (2) immediately after petals fall, and (3) 10-14 days later. Burn the fallen leaves.
	Powdery mildew	White, fluffy, or powdery growth on leaves.	Spray with lime-sulphur, wettable sulphur or Bordeaux mixture.
Plum	Plum pocket	Small, whitish spots on fruits a week or two after blossoms drop. Affected fruit becomes puffy and enlarged into bladder-like structures with a grey powdery covering.	Prune branches severely and spray with lime-sulphur just before the buds open.
	Silver leaf	Branches bear leaves having a dull leaden or metallic lustre and may die the first season that silvering appears.	Remove and burn branches at first sign of silvering. Heavily diseased trees should be dug out and burned. Paint or shellac pruned surfaces.

IMPORTANT

Mention of a trade name does not constitute a recommendation. The name is only used as an example of the type of product that is effective for the particular purpose.

INSECTICIDES

Cultural practices are effective and practical for the prevention of damage by some insects. Before applying insecticides find out whether the insects can be culturally controlled. If not, chemical measures should be used if expected damage will justify their cost.

Efficient chemical control depends on knowledge of habits and seasonal development of pest insects, early recognition and identification of insect damage, and proper timing and application of insecticides.

Warning — Most insecticides should not be applied to forage or pasture intended for milk cows or for animals going to slaughter in the current year. These chemicals remain in small amounts as residues on the foliage and, when eaten, concentrate in fairly large amounts in butterfat and in the body fat of the animal. The health of the animal may not be affected but the meat and milk can be a hazard to the health of humans consuming them. The producer should realize that he has a definite responsibility in this matter. In addition, it should be noted that contaminated milk or meat products are liable to confiscation at the expense of the producer.

INSECTICIDE FORMULATIONS

Insecticides are sold as prepared mixtures or formulations. Formulations are designed for specific purposes, ease of handling, and for reduction of hazards to animals and plants.

Emulsifiable concentrates are insecticides dissolved in a solvent or oil with an added emulsifying agent. These form emulsions when added to water. They do not readily settle out and can be sprayed with low-pressure equipment.

Oil solutions contain insecticides dissolved in suitable solvent mixed with oil, to be sprayed directly without further dilution. These are not to be applied to plants but are used on livestock and as space sprays.

Wettable powders are fine dust particles impregnated with insecticide with a wetting or emulsifying agent added, which permits the particles to be suspended in water. They require constant agitation and can be used only with piston or diaphragm pumps, as they cause severe wear in gear-type or impellor pumps. They should be sprayed at high pressures as they clog low pressure nozzles. Wettable powders may be used in combination with fertilizers or as seed dressings. However, specially prepared powders are more satisfactory for seed dressings.

Dusts are fine particles of an insecticide, mixed with an inert carrier such as talc. They cannot be mixed with water but must be applied with a dust applicator. Coarse forms are marketed as granular insecticides and are replacing dusts for mixing with fertilizer.

Insecticide-fertilizer mixtures are fertilzers that have been impregnated with insecticides or dry mixtures with granulated insecticides.

How to Calculate Amount Required

Control recommendations are usually given as the weight of toxicant (actual poison) per acre. If this information is not given on the label, it is necessary to convert the recommendation to equivalent amounts of insecticide.

The labels of emulsifiable concentrates usually specify the weight of toxicant in pounds per gallon of liquid. However, the labels of some only specify the percentage concentration; thus a 50 per cent solution would contain 5 pounds of toxicant per 10 pounds of the liquid.

(For easy conversion see table on next page.)

See "CHEMICAL CONTROL OF CROP INSECTS", Alta. Dept. Agr. Publ. 139, for recommended insecticides. This publication is issued yearly. Obtain your copy from your District Agriculturist or the Extension Service, Alta. Dept. Agric., Edmonton.

AMOUNTS OF FORMULATION NEEDED PER ACRE TO OBTAIN SPECIFIC AMOUNTS OF TOXICANT PER ACRE

Commercial Preparation or Formulation	Rate of toxicant recommended per acre					
	Ounces			Pounds		
	2	4	8	1	2	5
Dusts						
1%	12 1/2 lbs.	25 lbs.	50 lbs.	100 lbs.	200 lbs.	500 lbs.
2.5%	———	10 lbs.	20 lbs.	40 lbs.	80 lbs.	200 lbs.
5%	———	———	10 lbs.	20 lbs.	40 lbs.	100 lbs.
10%	———	———	———	10 lbs.	20 bs.	50 lbs.
Wettable Powder						
15%	———	1 2/3 lbs.	3 1/3 lbs.	6 2/3 lbs.	13 1/3 lbs.	33 1/3 lbs.
25%	1/2 lb.	1 lb.	2 lbs.	4 lbs.	8 lbs.	20 lbs.
50%	1/4 lb.	1/2 lb.	1 lb.	2 lbs.	4 lbs.	10 lbs.
75%	1/6 lb.	1/3 lb.	2/3 lb.	1 1/3 lbs.	2 2/3 lbs.	6 2/3 lbs.
Emulsifiable Concentrate						
1.5 lbs. toxicant/gal.	1/3 qt.	2/3 qt.	1 1/3 qts.	2 2/3 qts.	1 1/3 gals.	3 1/3 gals.
2 lbs. toxicant/gal	1/2 pt.	1 pt.	1 qt.	2 qts.	1 gal.	2 1/2 gals.
4 lbs. toxicant/gal.	1/4 pt.	1/2 pt.	1 pt.	1 qt.	2 qts.	1 1/4 gals
8 lbs. toxicant/gal.	1/8 pt.	1/4 pt.	1/2 pt.	1 pt.	1 qt.	2 1/2 qts.

APPLICATION OF INSECTICIDES

INSECTS IN THE SOIL

Broadcast soil treatment. May be applied to soil surface as dusts, granules, or sprays. May be done on summerfallow or just before planting but should be followed immediately by cultivation to a depth of 3 to 4 inches. Though more expensive than other methods, this will give satisfactory control for a longer period.

Side Dressings — Recommended for some insects attacking row crops. Apply the insecticide in bands along one or both sides of the crop row. Liquid, dust, or granular formulations, and insecticide-fertilizer combinations may be used but should be well mixed with the soil.

Seed treatments protect the germinating seed and emerging seedling. A fungicide is often included. Apply to seed coat as a dust with a sticking additive, or as a liquid. May not reduce the insect population sufficiently to protect from insect damage the following season, especially where row crops follow treated grain.

INSECTS ON FOLIAGE

Spraying and dusting. For insects that feed above ground spray with emulsions or wettable powders, or apply dusts. Ensure coverage on both sides of the leaves and follow all directions on the label very closely. Spraying or dusting should never be done during a strong wind. If possible, spray and dust at right angles to the wind. This reduces danger to the operator from prolonged exposure to the insecticide.

APPLICATION EQUIPMENT

Low-volume, low-pressure sprayers may be used for emulsifiable concentrates but are **not** constructed to handle wettable powder suspensions.

A conventional weed-spraying boom is effective for broadcast applications. For mature row crops a special boom, such as that used on a potato sprayer, is essential to concentrate the insecticide along the row and to cover under-sides of the leaves. When using these sprayers for insecticides, the delivery rate should be approximately 5 to 10 gallons per acre to ensure proper dispersal.

High - pressure piston - type sprayers are more versatile and are preferred for insecticides. They are suitable for wettable powder suspensions that require high pressures to prevent clogging of nozzles and may also be used at lower pressures for broadcast or row crop application. When equipped with spray guns they are suitable for spraying livestock, barns, corrals, and shelter-belts.

Dust applicators, power driven, will apply dusts uniformly under calm conditions. The efficiency of dusting can be increased, especially on mature crops, if a canvas sheet is pulled immediately behind the dust boom. The fertilizer attachment on most seed drills may be used to apply dust and granular formulations for soil insects.

Small aircraft are often more efficient and economical than other methods, especially if crops are mature and thus subject to injury by ground equipment. Aircraft sprays are fine mists. To avoid losses from drift and uneven coverage, calm conditions are essential. On hot calm days aircraft sprays are subject to upward air currents, thus preventing adequate coverage.

CALIBRATING BOOM SPRAYERS

1. Measure length of boom in feet.
2. Divide the length of the boom into 43,560 sq. ft. (1 acre) to determine the distance required to cover one acre.
3. Measure off this distance or a fraction of it.
4. Fill tank with water, operate to fill spray system, refill tank.
5. Spray the measured distance (3) as you would spray the field. Record speed of tractor and pressure of sprayer.
6. Carefully measure the volume of water required to refill the tank. This is the volume sprayed.
7. Convert the volume sprayed to volume per acre delivered by the sprayer at the recorded speed and pressure.
8. The volume per acre delivered (7) divided into the volume of the tank will give the acreage that will be covered by a tank-full of spray. This is the **acre-capacity** of the tank at that pressure and speed and for the type of boom used.
9. Place the amount of toxicant recommended per acre, multiplied by acre-capacity of the tank, in a partially filled tank and fill with water.

CARE AND MAINTENANCE OF SPRAYING EQUIPMENT

Check the equipment with water for leaks, clogged nozzles, etc., before operation. Breakdowns during operation require

repairs to equipment that may contain extremely toxic materials. Agricultural chemicals can be very corrosive; they react with unprotected metals, rubber hose, and hose connections. Solutions of insecticide should not be left in the sprayers. Wettable powder suspensions are very abrasive and should only be used in specially designed equipment.

All spraying equipment should be thoroughly rinsed. Spray tanks should be washed out, drained, and allowed to dry with the cover off. Pumps and hoses should be drained to prevent damage from frost. Nozzles should be removed and cleaned.

To lessen the danger of herbicide contamination:—

1. Fill and flush out the sprayer three times with clean water.
2. Fill the tank with a mixture of warm water and household ammonia (1 cup ammonia to 3 gallons water). Leave this in the tank for 1 to 2 days and then run it through the machine. More rapid results can be obtained if household ammonia is used with steam.

PRECAUTIONS

Insecticides are poisons developed to kill insects and they can be extremely hazardous. **Humans and animals can be accidentally poisoned by swallowing the insecticide, by eating insecticide-contaminated food, or by prolonged exposure to dusts and sprays.** Continued exposure to small quantities may not cause visible symptoms but can damage the liver or other vital organs and can accumulate in the fat and milk of animals.

If blurred vision, headache, tightness of chest, or nausea are noticeable after exposure to insecticides, **call a physician at once or take the victim to a hospital immediately.** Be certain what insecticide was used. Take the label of the container to the doctor, as the antidote is listed on it.

The following precautions should be adhered to whenever insecticides are used:—

1. **Read the label on the container. This** may save your life and prevent accident. It will name the product and its most effective use. It will also tell how to handle the material and what should be done in case of accident.
2. Wear protective clothing, e.g. coveralls and rubber gloves. Special care should be exercised with concentrates. Respirators or dust proof masks should be worn for volatile materials or extremely toxic dusts or sprays.
3. Change contaminated clothing as soon as possible and wash before re-use.
4. If pesticides are spilled on the skin, wash immediately and thoroughly with soap and water.
5. While spraying or dusting, prolonged exposure should be avoided, sprays and dusts should not be inhaled, smoking (especially hand - rolled cigarettes) should be avoided, and all exposed parts of the body should be washed immediately after.
6. Do not contaminate feed or water for livestock. Follow the rates of application shown on the labels, and strictly observe the cautions with regard to the use of treated crops.
7. Keep all pesticides in their original containers with proper labels. Store them in a safe place away from food or where food is handled. Keep out of reach of small chlidren, pets, or irresponsible persons.
8. Destroy all pesticide containers by burying or burning and avoid smoke from such fires.
9. Equipment must be in good working order to avoid leaks and clogging, and should be thoroughly cleaned after use.

WHEAT STEM SAWFLY

Life history. The adults emerge from stubble during the latter part of June and fly for two or three weeks. The female lays her eggs inside wheat stems. Each will lay in about 40 stems. In less than a week the egg hatches into a larva that tunnels inside the stem. In August, the larva cuts the stem at ground level. It then plugs the upper end of the stub, which remains in the ground, and forms a cocoon in which it spends the winter. The larva changes into a pupa in May and about a month later the adult emerges.

Recognition. The adult, about ⅜ of an inch long, is mostly black, with two pairs of dark colored wings and with yellow bands around its abdomen. Because of its dark color, its small size, and its habit of

flying close to the ground, it is seldom noticed. The larva is white, with a brown head and a small brown posterior spike. When removed from the stem the larva is S-shaped.

Infested stems after the second week in July usually contain "sawdust" and one or more nodes are hollowed out. After the wheat is ripe sawfly stubs are easily found by pulling up the stubble. Both stubs and stems cut by sawflies are recognized by their neatly cut ends plugged with "sawdust".

Control. Grow resistant or immune crops. Of the three resistant bread wheats, Rescue and Cypress are more resistant than Chinook. All depend on solid stems for their resistance; susceptible varieties have hollow stems. Prolonged cloudy weather during June and early July will produce less solid stems and reduce resistance. However, the seed from these plants will produce solid-stemmed resistant plants if grown with adequate sunlight. Most barleys and durum wheats have some resistance. When winter wheat is late in relation to the time of the sawfly flight it will be heavily damaged. Crops other than wheat, barley, and spring rye are immune.

Shallow tillage will help as most larvae die in exposed stubs. The one-way disc or the discer are the best implements. They must be set to pass just below the crown of the plants to expose the maximum amount of stubble. Unless the stubs are left on the surface the operation is not effective. Tillage is effective between the first week in May and the first week in June. Fall tillage is effective at any time. Burying the stubs only ensures good survival unless they are at least five inches below the surface.

If the crop is more than 25 per cent infested, it should be swathed slightly on the green side before it is cut by the sawflies. To determine infestation split at least 10 stems from the crop edge and examine for larvae or "sawdust". Make similar examinations at intervals of 10 paces into the field. Infestations are usually heaviest at the margins. Swathing does not kill the larvae as they are low in the stems at this time. Remember that sawflies, by feeding in the stems, reduce the yield in the infested plants by 10 - 20 percent; swathing early only prevents part of the damage.

Burning the stubble is **not** recommended. It does not kill the sawfly larvae but destroys beneficial parasites.

Present Status

The wheat stem sawfly has been at a low level in Alberta partially because of large acreages of resistant or immune crops. In addition, the wet summer and fall of 1954 caused considerable reduction in numbers. The parasites of the sawfly, favored by late ripening crops, increased greatly in 1954 and remained at a high level. In dry years maximum parasitism has been about 10 percent, but in wet years it has reached 70 to 80 percent. Most parasites overwinter in the stubble above ground. Control should be continued since native grasses are permanent sources of infestation.

INSECTS IN FARM-STORED GRAIN

Insects will multiply rapidly in moist grain, causing it to heat. Grain that is uniformly dry will not spoil or become infested.

The common pests in stored grain are the rusty grain beetle, several kinds of fungus beetles and mites. Fungus beetles feed on molds in damp grain. They do not attack sound kernels. Larvae of the rusty grain beetle feed on the germ-end of wheat, oats, and barley. Mites feed on grain dust as well as on kernels. Grain infested with mites usually has a musty odour.

Preventive control measures are easier and more economical than curative ones. First, the granary should be swept thoroughly and made weatherproof. If the floor and walls are damp, sweep hydrated lime into cracks. Next, spray all inside surfaces with a recommended bin spray.

Do not put new grain on top of old grain. New grain often contains more moisture than old and will attract insects. Destroy old grain on the ground near the granaries. It usually contains insects. Keep ventilators open during dry weather.

Examine stored grain every two weeks. Feel with the hand and probe deeper with an iron pipe to detect "tough", damp, or heating grain. During warmer weather use water-proofed cups filled with water and sunk in the grain to within a half inch of the surface, three or four for each granary. Insects are attracted to the water and can be easily seen.

Move and clean infested grain during the winter. Infestations discovered in winter can be controlled by cooling the grain to 25° F. for seven to ten days. It should be cleaned and transferred slowly in thin layers during the coldest weather to piles outside or to another granary. Put it through

a fanning mill, combine, or threshing machine, or discharge it through a portable elevator into a sloping chute fitted with a six-foot section of screen. This will assist in cooling and drying.

Moving and cleaning grain in warm weather often gives satisfactory control when a good job is done. If not effective or possible, the only alternative is to fumigate.

Fumigation. A fumigant is usually applied as a liquid to the surface of the grain. It evaporates to form a poisonous gas that sinks through the grain. Fumigation is most effective on relatively dry, clean grain under warm, calm conditions. Use it in a tight granary or seal the cracks. "Tough", crusted, or mouldy and "hot spots" should be broken up before applying fumigant. "Hot spots" can often be more readily treated by direct application of fumigant through pipes. Before attempting to fumigate infested grain, obtain further details from your District Agriculturist.

REFERENCE :

Dept. of Agriculture, Ottawa.
Pub. 1131—Insects and Mites in Farm-stored Grain in Western Canada.

GRASSHOPPERS

Of several species, three cause most of the damage—the migratory grasshopper, the two-striped grasshopper, and the clear-winged grasshopper. They start hatching early in May in a warm, dry year and continue over a month or more. The young grasshoppers, called nymphs, are only 1/8 - 1/4 inch long. After growing and shedding their skin five or six times these nymphs become full-grown and winged sometime after the middle of June. A couple of weeks later they lay eggs until cold weather arrives. The eggs are laid in the upper inch and a half of soil in compact clusters called egg-pods, from 20 to 100 eggs per pod, depending on the species. The number of pods laid depends on weather, type and abundance of food.

A few species of grasshoppers lay their eggs in early summer. These hatch in late summer and the nymphs overwinter. The first warm weather of spring makes them active, which causes reports of "early hatching". These 'hoppers are not injurious to crops.

Natural enemies—Eggs are destroyed by insects, birds, and rodents. Wasps, ants, and spiders prey on the nymphs. Both nymphs and adult grasshoppers are eaten by birds and small mammals. Some are infested internally by maggots of certain flies. A fungus disease is always present that with proper weather can kill many grasshoppers and even destroy a serious infestation. The dead grasshoppers seen clinging to the tops of tall weeds have been killed by this disease.

Where infestations arise—The two-striped and clear-winged grasshoppers lay most of their eggs on roadsides, headlands, and pastures and the young nymphs move into adjacent fields. The migratory grasshopper lays its eggs in the previous year's stubble fields. Infestations from flights into an area are relatively rare and occur only when the general level of infestation across the prairie region is very high.

Crops attacked—Cereals, flax, and alfalfa are the crops usually attacked although in severe infestation almost any crop may be damaged. Tender vegetation is preferred, and the insects will move from ripening cereal crops to green flax or into winter wheat or cover crops. Adults can cause severe damage by cutting through the stem below the head, and dropping the head or flax bolls.

Fall sown grain and cover crops—These are a special problem in control. Comparatively few adults can cause heavy losses. They will move from the maturing spring-seeded crops into adjacent seedling crops and back again in the evening. Therefore, poison a strip inside the edge of the maturing crop as well as a strip inside the edge of the seedling crop. Several applications may be needed. Early seeding of the winter crop using a heavier seeding in the outer one or two rounds will help withstand damage.

Control — An annual forecast map is issued showing where precautions will be necessary. Stubble fields should be cultivated in the fall if practical. Spring cultivation is effective in starving young 'hoppers. Do not seed infested stubble fields. Cultivation of these fields will spread them to other fields. Such fields should be worked into narrow "trap" strips that can be poisoned before cultivation is completed. Summerfallow will have practicaly no eggs.

Poisoning is effective and inexpensive if done early. Watch for the young 'hoppers in ditch banks, headlands, pastures, crops in stubble, and crop margins. Poison when nymphs become numerous.

Approved insecticides for grasshopper-control are distributed by the department through municipal districts and counties. Apply to your local district office. Read the label on the container of the insecticide

and use the rates recommended. Smaller rates are for young nymphs, the larger for older nymphs and adults or where longer poisoning is required.

Dusters and low-pressure sprayers may be used. Blower-sprayers or side delivery sprayers are effective for roadsides and fence lines. Aircraft are suitable for large areas or where ground equipment would cause damage.

Avoid killing bees by treating before bloom, otherwise spray when bees are absent, that is in the evening. Notify local bee-keepers.

REFERENCES :

Dept. of Agriculture, Ottawa.
Pub. 1036—Control of Grasshoppers in Prairie Provinces.
Pub. 86—Control of Grashoppers in Vegetable Crops and Orchards.

Dept. of Agriculture, Edmonton.
Pub. 139—Chemical Control of Crop Insects.
Pub. 145—Grasshopper Control in Alberta.

CUTWORMS

Cutworms are the larvae of moths ("millers") seen around lights during the summer and early fall. Cutworms are fleshy, soft-bodied worms that curl up when disturbed. Full-grown, they are about 1½ - 2 inches long; the upper half of the body is darker than the lower, and the backs and sides may be striped.

Most common cutworms pass the winter as eggs or partly-grown larvae. Damage is most serious during May and June. They usually feed at night, cutting off plants at or near the surface. Dry weather during the spring and summer favours increase. Under these conditions examine fields frequently and apply prompt control.

PALE WESTERN CUTWORM

The pale western cutworm is the most common on the prairies. They are of a uniform slate-grey colour with a light yellowish head, on the front of which are two, distinct, short black dashes.

The moth (adult) flies from about August 10 to September 15 and lays her eggs in loose, dusty soil, and these hatch early the next spring. The larvae feed on various green growth until late in June when they change to brown pupae and later to moths.

Prevent infestations by destroying all green growth on fallow during late July and leaving undisturbed by tillage, or livestock, until after September 15. In years of severe outbreaks, stubble fields should not be seeded.

Control. Very young cutworms can be starved in the spring by removing weeds and volunteer growth and delaying 10 - 14 days before seeding. The early growth should be 1 - 2 inches before cultivation. This method is recommended chiefly for stubble fields.

Chemicals may be used before damage is too extensive or just before reseeding. (See references.)

RED-BACKED CUTWORM

The red-backed cutworm occurs most frequently in parkland areas or, occasionally, in sugar beets. They are moderately gray in colour on the upper half of the body and have two, broad, dull-red stripes along the back.

Moths lay eggs in late summer and early fall in loose soil. Hatching occurs the following spring and the larvae feed as soon as green growth appears. When full-grown, usually toward the end of June, they change to brown, inactive pupae, and later to moths.

Prevention — Use methods described for the pale western with one notable difference. Weeds should be destroyed in late July and fallow left undisturbed and crusted throughout August. However, if a heavy weed growth develops in August, it should be destroyed as moths prefer laying eggs in weedy summerfallow. They also lay in weedy patches in crops.

Control with insecticides is described in "Chemical Control of Crop Insects." (See references.)

OTHER CUTWORMS

The army cutworm occurs in southern Alberta and damages cereal crops, mustard, and flax. They are usually dark olive-green all over, sometimes with two rows of poorly defined creamy spots, or with a dull yellowish-brown band, along the top of the body. Eggs are laid in the fall. The larvae feed before winter, and are about half-grown by spring.

As this cutworm often appears quite suddenly in the spring, early examination of fields is recommended. They usually complete feeding before the end of May. If crops are seeded early or larvae are feeding later than normal, they can be controlled with insecticides. See "Chemical Control of Field Crop Insects."

The wheat head armyworm is found on the heads of maturing wheat, yellowish with broad stripes.

A variety of cutworms infest gardens and, in some years, are very destructive.

REFERENCES:

Dept. of Agriculture, Ottawa.
Pub. 109—Pale Western Cutworm Control.
Pub. 81—Cutworms.

University of Alberta, Edmonton.
Bull. 24—Insect Pests of Grain.
Bull. 55—Insects of the Alberta Farmstead.

Line Elevators Farm Service, Grain Exchange Bldg., Winnipeg.
Field Crop Insects in the Prairie Provinces.

Dept. of Agriculture, Edmonton.
Chemical Control of Crop Insects.

WIREWORMS

Description—Wireworms are hard-bodied, slow-moving "worms", varying from yellowish - white to straw color. They do not curl up when disturbed. Fully developed larvae vary from ⅜ - 1 inch in length, and have flattened, notched tails. This is the stage that causes damage. The adults are called "click beetles" because they spring into the air with a clicking sound when placed on their backs. No other beetles do this.

Life history—Wireworms take from 1 to 10 or more years to develop from egg to adult. In late July or early August, some of the oldest larvae come up to within 2 - 5 inches of the surface and pupate. The pupae change to beetles, which remain in the soil over winter. They appear on the surface as soon as the soil warms in spring. Eggs are laid in May or June and soon hatch.

Early each spring the wireworms feed near the surface. As the surface becomes hot and dry, they go deeper. In irrigated lands they feed longer than in dry land.

Distribution — Wireworms occur in most fields, but are most common in light, well-drained soils; heavy soils are almost free. Under irrigation, damage is usually confined to drier knolls and ridges.

Damage—In cereal crops damage is indicated by thin, patchy stands. The entire crop may be destroyed.

Wireworms first feed on seeds. Later they shred underground stems but seldom cut them off; these injured plants gradually turn brown and wither. Wireworms also bore into the central shoots of older plants, causing the central leaves to turn yellow, and tunnel into the tubers, stems, and roots of vegetable crops.

Choice of crops—Wheat, spring rye, corn, and potatoes are very susceptible. Barley and early-seeded oats are more resistant. Flax may suffer on new breaking, but generally escapes damage, as does winter wheat, fall rye, sweet clover, and alfalfa. Sugar beets can stand thinning without serious loss in yield.

Control—Seed treatments of cereals will give adequate control. Insecticides can be used alone or with a mercuric fungicide for seed-borne diseases. One seed treatment properly applied usually reduces wireworms so that little damage will occur in subsequent crops. Seed dressings should not be applied earlier than 5 or 6 months prior to seeding. Longer storage may damage the seed and reduce wireworm control. Follow label directions. Do not apply combination dressings to seed already treated with a fungicide.

Use good seed and seeding practices to increase plant vigour. Avoid very early or very late seeding. Seeding too deeply will reduce the effectiveness of the insecticide. Recommended farming practices, especially clean summerfallowing, should be carried out. Watch for damage in future crops, and treat again when necessary.

Corn, peas, sugar beets, sunflowers, and beans may be safely treated. Combination dressings containing mercury should not be used on legumes such as peas and beans.

Chemical soil treatments are much more expensive than seed dressings but give better control for a longer period. They are recommended only for gardens or for sugar beets, potatoes, or other high-value crops.

Infested soil may be treated in fall or spring. The insecticide should be broadcast as a dust or spray and immediately worked in 4 - 6 inches deep. This should free the land for several years. Watch for damage each year and treat again when necessary.

Potato growers in southern Alberta have successfully used a band treatment of insecticide pre-mixed with fertilizer and dispensed from the fertilizer-hoppers at time of seeding.

Do not use lindane as a soil treatment on land where potatoes or edible root crops are to be grown because of the danger of taint and retarded growth.

Clean fallow every two or three years will reduce wireworm populations. Destroy all green growth during June and July. Do not work deeper or more often than is necessary for weed control.

Reseeding may be done on dry-land fields where a crop has been destroyed without danger of further serious damage.

BEET WEBWORM

Primarily a pest of sugar beets, it will feed on mustard, flax, peas, rape, alfalfa, lambsquarters, and Russian thistle.

Description. The larvae on hatching are pale green and about 1/16 inch long. They are found on the underside of leaves and hang by threads when disturbed. Fully grown larvae are 1 - 1½ inches long, olive-green with light and dark stripes. They pupate in the soil. The pupal cases are about 1 - 1½ inches long, and are constructed of silk covered with earth.

The adult is a grayish-brown moth with cream-colored markings on the wings, about ½ inch long with a wing span of about 1 inch. At rest, the moth appears triangular and is easily recognized by its short, rapid, zigzag flights. The eggs are pearly-white, and disc-shaped.

Life history. In June the moth lays eggs singly or overlapping in rows on the underside of the leaves. Eggs hatch in 3 - 5 days. Young larvae eat only the underside of the leaves, but as they grow they eat through and may leave only the veins. They develop so quickly they may cause considerable damage in one day.

Fully grown larvae drop from the plant

and enter the soil to pupate. In about one month the moths emerge and start the second generation, which over-winters as pupae. Both May - June and August broods can cause reduction in yield and sugar content.

Control. Fields should be checked carefully during the moth flight for eggs and newly hatched larvae. Control should be applied early when more than one half grown larva per leaf is found on 50 per cent of the leaves.

Poison and application rates vary with crops. See "Chemical Control of Crop Insects" and your District Agriculturist.

SUGAR-BEET ROOT MAGGOT

The maggot feeds on the beet root, causing "bleeding" and wilting. Severe infestations may reduce yield by 3 - 8 tons per acre. The severest injury occurs during July and early August. Feeding allows root-rot organisms to enter the beet and cause further damage.

Description. The egg is white, slender, and slightly curved. The maggot (larva) is white, without legs, eyes, or a distinct head. It is largest at the rear, tapers toward the front, and is up to about ½ inch in length. The brown pupal case is oval and slightly shorter than the maggot. The fly is black, about ¼ inch long, with two transparent wings, each with a dark area on the front margin.

Life history. The maggot over-winters as a mature larva, 8 - 14 inches in the soil. In early spring it moves to 3 - 4 inch level and pupates. The fly emerges about thinning time and lays its eggs around a host plant. The maggots crawl below the surface. As the soil warms or dries, they move deeper. There is generally only one brood a season.

Control. Early seeding in well prepared and fertilized seed bed, followed by adequate irrigation, will reduce losses. Crop rotation and weed control along field margins and ditches also will help. Beets should not follow beets. For chemical control consult your fieldman.

SUGAR-BEET ROOT APHID

The principal summer hosts are sugar beets, table beets, lettuce, and lambsquarters. Others are spinach and Swiss chard. The aphid sucks the sap from the rootlets. If there are many the plants will wilt. Frost damage is more severe on heavily infested plants.

Description. Wingless aphids and a white mold-like substance will be noticed on the roots and in the soil. Late in the season winged aphids may be found.

Life history. The winter is passed either in the soil or as an egg on poplar trees. Beet crops may be infested from either source. When poplar leaves open, a wingless aphid hatches from each egg and lays its young. These develop wings and in June and early August fly or are blown to beets. In late summer and early fall, the winged forms fly to poplars and give birth to wingless males or females. After mating one white egg is laid in a crevice in the bark where it over-winters.

Control. The best method is to plant early, to irrigate early and frequently, and to keep soil fertility high.

Rotation is not effective and there is no satisfactory chemical control. Insecticides destroy the predators that aid in control.

> See "CHEMICAL CONTROL OF CROP INSECTS", Alta. Dept. Agr. Publ. 139, for recommended insecticides. This publication is issued yearly. Obtain your copy from your District Agriculturist or the Extension Service, Alta. Dept. Agr., Edmonton.

Crop	Pest	Description
Forage		
Alfalfa	Alfalfa Weevil	Small, dark brown weevils, overwinter as adults. Lay eggs in stems of new growth. Larvae skeletonize leaves, cause silvery appearance just before first bloom.
	Sweet Clover Weevil	Occasionally attacks alfalfa near newly cut sweet clover. Adults similar to alfalfa weevil. Cause notching in leaves unlike damage by alfalfa weevil.

Crop	Pest	Description
Sweet Clover	Sweet Clover Weevil	Small, inconspicuous, dark grey snout beetle, three-sixteenths inch long, chew crescent-shaped notches in leaves during whole season. Over-wintering beetles destroy crop as it emerges in spring. Newly emerging beetles in early August destroy seedlings. Seed new stands as far as possible from old. Use shallow tillage in late July, just after removing hay crop, to destroy insects. Much of the damage attributed to this weevil is actually poor winter survival of the clover.
Grasses	Silver Top	Sterile white heads in bluegrasses caused by a small mite. Control by fall or early spring burning.
Oil Seed		
Mustard Rape Seed	Diamondback Moth	Caterpillars are light green with greenish brown heads, about one-third inch long when mature. They wiggle vigorously and drop on silken threads when disturbed. Similar damage to the leaves as the cabbage worm. Several generations per season. Forms lace-like cocoons attached to leaves.
	Flea Beetle	Adult is a small, shiny metallic green to black beetle that jumps rapidly when disturbed. Small holes are eaten into or through the leaves especially on young plants; these plants may be killed.
	Beet Webworm	See Vegetable Crops.
	Red Turnip Beetle	Up to one-half inch long, red with three black stripes on back. Overwinter as eggs in soil. Small black larvae, similar to those of potato beetle, feed on plants at night.
Vegetable		
Cabbage Cauliflower Radish Turnip Swede Turnip	Cabbage Worm	Adult is white butterfly commonly seen in gardens. Larvae are velvety green caterpillars, up to one inch long, with a faint golden line down the back. Leaves and heads are severely chewed and green to black excrement pellets cling to the leaf surfaces.
	Cabbage Looper	It is about the same size as the cabbage worm and does similar damage. It is distinguished by the peculiar looping of the mid-part of the body when it crawls.
	Flea Beetles	See Oil Seeds in previous section.
	Cabbage Maggot	Adult is a gray fly similar to a housefly in size. The larvae are white maggots that tunnel into the roots causing death of very small plants, especially trans-planted cauliflower and severely damaging the roots of turnips and radish.
Carrots	Leafhoppers	Small, gray-green, wedge-shaped bugs that feed by sucking plants, and transmit the virus disease, aster yellows. Adults jump and fly readily when disturbed. Disease usually not of economic importance in Alberta.

Crop	Pest	Description
Corn	Corn Earworm	Fully grown larvae are green to yellow and usually have conspicuous cream, yellow. brown or black stripes. Serious damage especially to early corn in some years when the larvae feed down the silks and into the tip of the ear. They never bore into the shank.
	European Corn Borer	Larvae are uniformly dirty white or pinkish covered with rows of small brown spots, about one inch long when mature. Chew small holes in the leaves, then tunnel into the stem, causing tassel breakage. Worms will tunnel into the ear stalks and into the kernels. Report occurrence to Department.
Onion	Onion Maggot	Adult is a fly that closely resembles the housefly. The maggot is creamy white, legless, about one-quarter inch long when fully grown. It attacks the root causing young plants to wilt and die. Older plants have bulbs infested and may rot.
Potato	Colorado Potato Beetle	Adults are hard-shelled beetles about three-eighths of an inch long, yellow with ten black stripes lengthwise on the wing covers. Larvae are soft-skinned, humpbacked, brick-red, with two rows of black spots on each side of the body. The grubs feed in clusters and completely consume the leaves.
	Wireworm	See section on wireworms.
	Leafhoppers	See carrots, above.
Many Garden Crops		
	Slugs	These pests are soft-bodied, slimy, legless, about one inch in length, with no obvious head. They leave a trail of slime. Young foliage particularly is eaten, almost always at night except when it is wet and overcast during the day.
	Blister Beetles	Long, narrow beetles with the head quite distinct from the rest of the body, strong fliers, active on the plants. They may be black, gray, brown, or blue, and spotted or striped. Plants are stripped of their leaves very rapidly and are ragged in appearance.
	Aphids	Small, soft-bodied insects, somewhat larger than a pin head, often clustered in colonies. Most are green, but they may be pink, yellow, black or white. Aphids suck the sap of the plant, especially growing tips, and the leaves may curl and wilt. Some aphids are responsible for spreading virus diseases.
	Cutworms Grasshoppers Beet Webworm	See respective sections.

Crop	Pest	Description
Small Fruits		
Currants Gooseberries	Currant Fruit Fly	Larvae are small white maggots that feed within the berries, causing discolored areas on the fruit and premature ripening. Adults are small flies that cluster in the bushes just prior to bloom.
Raspberries	Sawfly	Small, spiny, green caterpillars about the same color as the leaves. Cause tiny holes in the leaves at first, then skeletonize the leaves.
	Mites	Leaves speckled or blotched with gray patches, often fall prematurely. Mites are extremely small, white to green pests on the undersides of the leaves; they usually produce a webbing that becomes dusty.
Ornamentals		
Cotoneaster Mountain Ash Plum	Pear Slug	Humpbacked, smooth, slimy, black and yellow insect that resembles a slug. They eat one surface of the leaves, resulting in a brown appearance that looks like premature ripening.
	Oyster Shell Scale	Narrow, hard, gray-brown scales that may encrust whole areas of the branches. The crawlers are very small white insects that will infest the whole tree or shrub.
Gladiolus	Thrips	Very small, slender, brown to black insects about one-sixteenth of an inch long. The young are yellowish-green. Their feeding causes silvery streaks on the blossoms; spikes may be deformed.
Roses	Rose Weevil	Dark red or red and black weevil that bores holes into the centres of the rose buds so that no flowers are produced.
Virginia Creeper	Leafhopper	Small, narrow, very active, pale yellow to white insects that feed on the undersides of the leaves. Leaves have small, white feeding scars; eventually the whole leaf turns white and drops.

Recommendations for Chemical Control of Insects on forage, oil seeds, vegetables and ornamentals may be obtained from your District Agriculturist.

Crop	Pest	Description	Control (Follow manufacturer's directions for materials suggested)
Trees			
Spruce, pine, tamarack, balsam	Aphids	Clusters of small, soft, brown, green, or back insects on the trunks, branches, or twigs or amongst distorted needles at the tips of the twigs.	Spray trees thoroughly with Malathion.
Caragana, maple, elm, poplar, willow, ash, fruit trees	Aphids	Leaves curled or discolored by small, soft insects that cluster on the trunk, branches, leaves, or seed pods.	Spray trees thoroughly with Malathion. For those types that roll or curl the leaves, e.g., elm, spraying should be done as early in the year as possible.
Caragana, ash, lilac, honeysuckle	Blister beetles	Blossoms and leaves devoured by swarms of large, active beetles.	Dust beetles with DDT or spray with Chlordane.
Poplar, ash, birch, pine, spruce	Borers	Trees or branches weaken and die; holes in the stems and branches, areas of dead bark, caused by white grubs burrowing in the wood. Grubs present all year.	Special treatment required. Send sample of grubs and damage to the Forest Ent. & Path. Lab., 102 - 11 Avenue East, Calgary, Alberta.
Manitoba maple, elm, ash, fruit trees.	Cankerworm	Small holes appear in leaves; later foliage is completely eaten by brownish-green caterpillars that spin silken threads. Present in May and June.	As soon as foliage appears spray trees with DDT.
Manitoba maple, poplar, ash, elm, fruit trees	Cecropia Caterpillar	Leaves devoured in July. Young caterpillars are blackish, spiny; older ones are large, green, with vari-colored projections. Winter in large, brown, silken cocoons on twigs, weeds, etc.	Spray caterpillars with DDT. Hand-pick and destroy caterpillars and cocoons.
Poplar, willow	Leaf beetles	Foliage skeletonized by black grubs, causing scorched appearance, or devoured by small to medium vari-coloured beetles, from May to August.	Dust or spray with DDT.

Crop	Pest	Description	Control (Follow manufacturer's directions for materials suggested)
Most fruit trees, poplar, willow	Tent caterpillar	Leaves eaten in May and June by dark, hairy caterpillars that cluster stems and branches which may or may not make tents; caterpillars often migrate in "armies".	Cut out and destroy tents during cool weather or at night. Dust or spray insects with DDT, derris, or pyrethrum.
Aspen poplar	Leaf rollers	Leaves rolled or curled in early spring. Small active caterpillars found in the leaf rolls; present in May and June.	Spray thoroughly with DDT. If area large, spray from the air with DDT. Contact the Forest Ent. & Path. Laboratory, 102 - 11 Avenue East, Calgary, Alberta.
Aspen poplar	Bruce spanworm	Leaves eaten and partly curled. Active loopers or measureworms that spin down on threads when disturbed. Dark to light green in colour; present in May and June.	Spray thoroughly with DDT or, if large area, spray with DDT from air. Contact the Forest Ent. & Path. Laboratory, 102 - 11 Avenue East, Calgary, Alberta.
Spruce, larch	Sawflies	Needles eaten by small green, brownish, or greyish-green "caterpillars" with shiny red or black heads; on spruce in June; on larch in July.	Spray insects with DDT, Chlordane, or Malathion.
Spruce	Spruce mite	Yellowish mottling of needles with fine, silk webbing around twigs between needles; mites almost too small to be seen. Present from early May to end of season.	Spray trees thoroughly with Kelthane — 5% or as directed on label, or Ovotran 50% wettable powder, 6 ounces to 20 gallons of water, during second week in May and again about mid-June.
Spruce, pine	Pine needle scale	Yellowish mottling of needles caused by small, waxy, white, elongate scale insects that are present on the needles all year.	Spray trees thoroughly with Malathion 50% emulsion, 16 fl. oz. to 20 gallons of water, at the end of first week in June, and again during second week in August.

For further information on shelter belt and forest pests write to the Forestry Ent. & Lab. Lab., 102 - 11 Avenue East, Calgary, Alberta, or Field Crops Clinic, Alberta Dept. of Agriculture, Edmonton, Alta. Send samples of insects and damaged plants.

Livestock

Livestock production is a major source of farm income and an indispensable part of balanced agriculture and permanent soil conservation. As breeding, feeding and management practices are improved there must be greater specialization within the industry. The individual farmer-producer may have to examine his operation with the view to greater specialization to meet competition.

Breeding, feeding and caretaking form the basis of livestock production. General principles, applicable to all classes of livestock, are set out herewith. It is well to understand these principles before undertaking a study of details.

SELECTION AND BREEDING

Consistent selection is the key to success in the genetic improvement of livestock. Only by culling the inferior individuals and retaining superior ones will progress be ensured.

Superiority must be measured in terms of economic worth. This includes weight for age, milk production, dependable reproductive performance and market suitability. Show ring standards tend to place undue emphasis on points other than performance. Livestock producers must seek other measures of economic worth in their selection programs.

Official Test Records

The Provincial and Federal Departments of Agriculture have made livestock testing programs available. The R.O.P. Policy for swine is an excellent guide to selection for rate of gain, feed conversion and carcass quality. Consistent use of R.O.P. records in boar selection is strongly recommended. For dairy cattle, R.O.P. and Dairy Herd Improvement Association tests supply information on milk and butterfat production that is invaluable in the selection of breeding stock. The Federal-Provincial R.O.P. policy for beef cattle, inaugurated in 1956 is designed to provide information on rate and efficiency of gain for this class of stock.

Test information may relate to the individual itself, to its brothers or sisters, to its parents, or to its progeny. The latter is known as the progeny test and, while the most difficult to obtain, is the most reliable as a measure of breeding worth. Sires whose offspring are above average performance should be continued in service as long as possible. Artificial breeding or the use of breeding crates can extend the use of proven sires.

Private Herd Records

Private records maintained by the breeder complement the official testing program. Such records often constitute the only basis for intelligent culling and replacement of breeding females. This is true for the commercial producer as it is for the breeder of purebreds. Minimum records consist of details of reproductive performance and mothering ability for each breeding female. To this should be added information on the vigor, growth and market performance of the progeny together with details of any defect such as dwarfism, ruptures, ridglings or intersexes (hermaphrodites). Families with inherited defects should be avoided.

Appraisal of the Individual

Selection is completed by appraisal of the individual itself. Vigor, weight for age, strength of feet and legs and mammary development are important. Number of teats has particular significance in swine and should be sought in the boar as well as the female.

In comparing animals from different herds, it is best to compare each animal with respect to its own herd average. Real genetic improvement can be expected only if the animals are above average in the desired traits.

Mating Systems

The mating system will depend upon whether the progeny are intended to be purebred seed stock or market animals. Producers of purebreds should use mild inbreeding or line breeding to promote genetic purity. This will permit greater accuracy in culling and will tend to develop a prepotent or true breeding line. When herd performance is high, inbreeding may become a necessity to avoid introducing stock of lower genetic worth.

Producers of commercial stock have the choice of crossbreeding or grading-up. Crossbreeding utilizes sires from two or more breeds while grading-up requires sires of one chosen pure breed. Either system will work well provided that selection is consistent and rigorous. In general, crossbreeding can be practiced successfully only in large herds and grading-up must be employed for the improvement of small one-sire herds.

The popularity of crossbreeding is due mainly to the increased vigor and growth in crossbred animals. Full advantage of hybrid vigor is unlikely to be realized unless the crossbred female is used for breeding. This is particularly evident with pigs for which the increased vigor of the hybrid dam can contribute materially to improvement in litter size and survival. Continuous crossbreeding, to yield satisfactory results, must be well planned in advance and the plan must be followed in detail.

Crossbreeding programs appear simple but they can lead only to mongrelization of the herd unless only young females are used for breeding in each generation OR unless sires of the two or more breeds are used simultaneously. The first alternative is impractical and the second requires large scale operations. Crossbreeding is not a cure-all for production problems. It may increase productivity if used in conjunction with but NOT as a substitute for good feeding, management and sanitation.

Grading-up has the advantage of straightforward simplicity. It is applicable to herds of any size and, since it presents no problems in the breeding of replacement females, is to be preferred to crossbreeding in small one-sire herds.

No breeding system will succeed unless based on sound selection. The choice of breed or breeds is secondary to the choice of the individuals which form the herd. Successful purebred or commercial breeding must utilize top quality purebred sires in every generation with selection, generation after generation, based on official as well as private records.

Artificial Insemination

—has brought top quality sires within the reach of many producers of beef and dairy cattle. As yet it has not been placed on a practical basis for swine.

The cost of artificial insemination is prohibitive unless an efficient service unit can be organized. Such a unit cannot operate on a practical cost basis unless at least 1,200 cattle are bred annually in an area of not more than 25 miles in radius, well serviced by roads and telephone. Producers of purebreds should also acquaint themselves with the ruling of their own breed organization concerning the registration of animals conceived artificially. For advice concerning artificial breeding write Live Stock Branch, Alberta Department of Agriculture.

NUTRITION

The function of livestock on Alberta farms and ranches is to convert grain and forage crops into concentrated and highly palatable, protective human foods. Within limits livestock can convert inadequate rations into milk, meat, work or wool, but feed is wasted and cost of production increased when livestock are forced to make do with something less than a balanced ration.

Feed is the largest single item in the cost of producing livestock. Most of the nutrients required are present in the basal feeds — roughage and grain — but NOT in the proportions required by the animal. Thus profits are in large degree dependent on the producer's knowledge and the extent to which he applies his knowledge of:

(a) the nutrient requirements of his animals at all stages of the life cycle.
(b) the nutrient properties of the basal feeds.
(c) ways and means of supplementing the basal feeds to make rations nutritionally complete at minimum cost.

Study of Table I in relation to the following comments will give a working knowledge of the above three factors and furnish reasons for recommendations in the sections that follow.

DIETARY ESSENTIALS

Water

Water is a very important nutrient and is required in quantity by all livestock. Efficiency of production is lowered if for any reason animals consume less than enough.

Energy

Carbohydrates, mainly starches and celluloses in grains and roughages, and fats are burned in the body to provide energy. Surpluses build new body tissues, chiefly fat. Surplus protein can be used for the same purpose but the real function of protein is to provide the building blocks for new body or milk protein. All the basal feeds and supplements used in livestock rations furnish energy but not at the same cost. The relative amount of energy in different feeds is indicated by the total digestible nutrient (TDN) value. Requirements for different purposes are shown in Table I.

Bear In Mind

1. Lack of sufficient energy is a common deficiency in livestock rations — for ruminants one of the commonest.

2. Rations deficient in energy are frequently deficient in palatability and in protein, minerals and vitamins.

3. The inherent will to live compels livestock to try to eat enough of even the most unpalatable and unbalanced rations to maintain body heat and essential body functions.

4. It is only from feed beyond the maintenance level that livestock produce anything for their owner. This means that if an animal requires 9 lbs. per day for maintenance, and the quantity consumed is 10 lbs., the animal will produce something for the owner from **one-tenth** of the feed. If the quantity eaten is 18 lbs., **one-half** of the total feed will go into something that the owner can sell.

5. Roughage feeds, other than lush pasture, are, even for ruminants, too bulky and too low in TDN content to provide for much beyond maintenance needs.

TABLE I

AVERAGE LEVELS OF SOME IMPORTANT NUTRIENTS IN COMMON FEEDS AND LEVELS REQUIRED IN RATIONS

	TDN %	Protein (1) %	Fiber %	Ca %	P %	Per lb. of feed Carotene mg.	Vitamin A I.U.
Cereal grains	76	12 (8-16)	6	0.06	0.37	0	0
Legume hays	49	14 (8-16)	30	1.36	0.23	2-20	0
Grass hays	46	7 (4-12)	32	0.34	0.15	2-15	0
Straws	42	4 (1- 5)	37	0.24	0.09	0	0
Vegetable prot. meals	74	37 (20-45)	8	0.32	0.75	0	0
Animal prot. meal	68	55 (40-75)	1.5	8.0	4.3	0	0
Range (2) of levels required (no factor of safety) in rations for:							
Beef cattle	50-68	7.5-12.5		0.14-0.37	0.15-0.28	0.6 -3.6	or 240-1440
Dairy cattle		Requirements not commonly listed in this manner, but are higher than those for beef cattle because good dairy cows produce more pounds of edible dry matter per day than do beef cattle.					
Sheep	50-65	7.0-11.5		0.15-0.30	0.14-0.22	0.4 -1.9	or 215- 775
Swine	75-80	13.0-18.0		0.55-0.80	0.33-0.6	0.75-2.5	or 450-1500

(1) The bracketed figures indicate the range of protein levels that may exist in grains and roughages of the same general description, and in protein meals of different types. Similarly levels of other nutrients may differ markedly from the average values for a given kind of feed. See page 179 re services available for analysis of farm-grown feeds.

(2) Low levels for maintenance, high levels for growth or production.

PROTEINS

With the exception of ruminants which can utilize some non-protein nitrogen from compounds such as urea, animals can build or replace body proteins only from dietary proteins. Protein deficiency is very common in livestock rations.

Bear In Mind

1. Protein is required in amounts varying from 7 to 18 percent or more of the total ration. The percentage necessary is highest during the more rapid stages of growth or production. Protein needs are higher for fast than for slow growing species.

2. It is apparent from Table I that:

(a) cereal grains do not contain sufficient protein for pigs;

(b) low grade roughages frequently contain insufficient protein to meet even maintenance requirements of ruminants;

(c) rations composed of average grain and good legume hays are likely to contain sufficient protein for beef cattle and sheep and to require relatively small additions of protein for dairy cattle.

3. Quality of protein is important for single-stomached animals, but less important for ruminants.

4. Compare prices of protein supplements on a basis of **cost per pound of protein — not** on a basis of price per 100 lbs. of supplement.

MINERALS

1. **Common Salt** — All feeds of plant origin are deficient.

2. **Calcium (Ca) and Phosphorus (P)**

(a) Ground limestone is a cheap and effective source of calcium, but **it does not contain phosphorus.**

(b) If P is required, a supplement containing 11% or more of P should be used. With few exceptions, such supplements contain more Ca than P even without the addition of ground limestone. Good P supplements are justifiably more expensive than ground limestone. **Price per 100 lbs. of supplement can be very misleading.** From the guarantee on the container calculate what you are paying for a pound of P. If the price is $6.00/cwt. and the product contains 15% P, the cost per lb. of P is 40c; if the price is $4.90 and the P content 7%, you pay 70c per lb. for P. If the product contains common salt, calculate how much you are paying for salt.

(c) Note from Table I that grains are very deficient in Ca, but are fair sources of P. Legume roughages are rich in Ca. All roughage feeds tend to be deficient in P. Mature or weathered roughages are likely to be seriously deficient in this important nutrient.

3. **Iodine** deficiency is very common in Alberta feeds.

4. **Cobalt** deficiency may be a problem in rations for ruminants.

5. **Iron** deficiency is seldom a problem except in suckling pigs.

6. **Zinc**— See "Swine"—zinc supplements are not recommended for other farm animals.

BEWARE

1. Periodically mineral supplements for which ridiculous claims are made, and which are not eligible for registration under the Canada Feeding Stuffs Act, are sold to farmers at high prices. Apply the calculations mentioned in (b) under "Calcium and Phosphorus". Consult your District Agriculturist.

2. Be careful about vitaminized mineral mixtures—some real problems are involved in stabilizing vitamins in such mixtures.

3. If a ration is deficient in protein, NO mineral or vitaminized mineral mixture will replace a protein supplement.

VITAMINS

Vitamin A

(a) Deficiencies of this vitamin are common in Alberta.

(b) Requirements are proportional to body weight; they are higher for lactating animals and during the last one-third of pregnancy than at other stages.

(c) Green feeds contain carotene which is converted into vitamin A by animals, but carotene is quite unstable and easily destroyed by exposure to air, heat, light or minerals so that green color is not a guarantee of high carotene content in stored roughages. Vitamin A also is unstable and subject to destruction under the same conditions as is carotene..

(d) Grains contain no carotene; brown or black silages, weathered hays, straw and winter forage contain little or none.

(e) Buy carotene or vitamin A supplements from reputable sources. Calculate cost on a basis of cost per milligram (mg.) of carotene or per million international units (I.U.) of vitamin A — **not** on a basis of price per pound of supplement.

Vitamin D is required for the formation of bones. There is no vitamin D in grain and comparatively little in most other farm-grown feeds. Direct sunlight, acting on substances in the outer coat of livestock, forms vitamin D. Guard against vitamin D deficiency (rickets) especially in all young animals that receive limited or no exposure to direct sunlight.

Other Vitamins — Deficiencies of other vitamins in rations for cattle and sheep are possible but not probable. Supplementation with vitamins other than A and D is recommended only under special circumstances. See page **109** for vitamin supplementation of rations for young pigs under conditions of stress.

BORDERLINE DEFICIENCIES OFTEN GO UNNOTICED BUT ARE THE MAJOR CAUSE OF LOSS

Economic losses due to **borderline** nutritional deficiencies are much greater than those attributable to **marked** or **complete** deficiencies. The effects of extreme deficiency in even one nutrient are so apparent that corrective measures are usually applied. Symptoms of borderline deficiencies are not dramatic and tend to go undetected. Inefficient use of feed, slow growth and fattening, low milk production, poor reproduction and high susceptibility to disease tend to become accepted as normal. The cumulative economic loss to the livestock industry is staggering.

MANAGEMENT

Management is merely the action program which applies the knowledge of breeding, feeding, the general care, and marketing of livestock, that has been accumulated through experience and research. Sound management entails considerable planning to attain maximum reproduction, maximum survival of off-spring, maximum production from the feeds available and minimum loss from nutritional deficiencies, disease and parasites, in order to market to best advantage, a quality product which has been produced at the least possible cost per unit. Efficient livestock operations may appear to vary considerably, and this is rightfully so depending on such factors as:

1. the location and size of the farm,
2. the labor available and the degree of specialization ,
3. the feeds most commonly available, and,
4. local marketing conditions.

This apparent variation in management is largely due to degree of application rather than a deviation from well established principles.

Livestock management tends to suffer if too many enterprises are carried on the farm. It is difficult under these conditions to have a good working knowledge of all the different enterprises, to provide the necessary equipment, and to utilize available labor to best advantage. Continuity from year to year in the same enterprise provides the best opportunity for high efficiency and to avoid waste and added expense from frequent changes of breeding stock and equipment.

The main factors in livestock management are as follows:

1. **Feeding Practices** involve **chores.** They should take advantage of every possible labor and time saving device. Regardless of the size of the operation, consideration of location of equipment, feed, bedding and water can greatly reduce chore time. Feed and labor are two main operating costs in livestock production and efficient use of both can reduce per unit or per animal cost.

2. **Housing** varies from fairly simple for beef cattle and sheep to more costly for dairy cattle and hogs. It must provide adequate protection from cold, proper ventilation, ease of cleaning, convenience in location and layout. Construction should be of the cheapest possible design and materials, consistent with a good degree of durability.

3. **Equipment** — Fences, pens, gates, chutes, squeezes and hurdles, are essentials in handling stock with dispatch and satisfaction. Lack of this equipment results in wasted time and neglect of necessary practices and treatments.

4. **Comfort of Animals** — Animals react favourably to comfortable surroundings. Ample bedding during cold weather and shade during very hot weather has been proven to more than pay for the cost.

5. **Breeding** — Time of breeding should permit birth dates to coincide with weather, housing or other protection available, advantage from seasonal markets, and distribution of available labor.

6. **Care previous to Breeding** — Breeding females are more productive when in moderate condition, on a well balanced diet and gaining in weight when bred.

7. **Care During Gestation**—Pregnant animals should have ample exercise. Special attention to diet is necessary to assure strong offspring at birth. Most common deficiencies are protein and vitamin A.

8. **Care at Birth** — Profit or loss may depend on the degree of care at this time. Special attention is doubly important to ensure that young animals survive the first few hours.

9. **Creep Feeding** is important to supplement milk supply, increase gains during the nursing period and reduce the degree of change at weaning time.

10. **Weaning** — Ages and methods may vary considerably but this should be recognized as a critical stage in any animal's life and should be done systematically.

11. **Treatments and Operations** — (a) Cattle — Identification (tattoo, ear tag, branding); castration; dehorning; warble fly control treatment; louse control; foot trimming.

(b) Swine—Clipping eye teeth from piglets without injury to the gums or mouth, identification (tattoo, ear tag or ear notching), iron for suckling pigs, castration; segregating for uniform size in feeding groups, detusking aged boars, foot trimming of sows.

(c) Sheep—crutching ewes before lambing, attention to acute udder inflammation, mothering up lambs, identification (tattoo, ear tag, ear notching, fleece branding), docking and castration of lambs, shearing, proper care and packing of fleeces, dip or spray for external parasites, drenching for internal parasites, predator control measures as necessary, special attention to udders, mouths and wool when culling out ewes, foot trimming of ewes.

12. **Diseases Prevention and Control** — Sanitation of premises, rotation of pastures and restricting visitors from feeding pens. Some diseases can be controlled by vaccines. In these cases vaccination should be standard practice. (see Veterinary section).

13. **Parasite Control** — Sanitation of premises and pasture rotation are leading factors. Parasite control measures should be routine with sheep husbandry. (see Veterinary section).

14. **Marketing** — Marketing systems are highly complex and not generally well understood by primary producers. As marketing is the final step in management, and price is the factor most likely to determine profit or loss, selling to advantage requires some study of markets. Two main divisions are usually available — the central market and the local market. The central market usually reflects a truer picture of supply and demand throughout the nation, particularly with respect to finished livestock. The local market has the advantage of less transportation cost but should be judged by the competition present. The rapid progress made by auction selling has been possible because producers desire to see open competition for their product. Producers are cautioned against selling locally on one bid unless they are thoroughly familiar with central market quotations and freight differentials. They are also cautioned against allowing transportation agencies to do their selling.

15. **Records**—Herd performance and accounting. Evaluating the performance of animals in a herd or flock can only be done if certain minimum records are available. Factors here are: identification, rate of gain, feed consumption and quality of product.

Only by accounting can the operator determine the value of his livestock enterprise in relation to his combined farm operation. (See Farm Management.)

BEEF CATTLE

Efficient beef production can be achieved only through the application of superior production techniques. Management and feeding offer an immediate means of progress. Breeding and selection offer progress on a longer term basis.

MANAGEMENT

Size of Enterprise depends on the feed and pasture available. Flexibility and sufficient scale to provide a reasonable labor and capital return are essential. Recommended minimum numbers in the main commercial enterprises are:

1. production of feeders: 150-200 cows.
2. farm production and finishing: 50-60 cows.
3. buying and finishing feeders: 50-75 head.

In Choosing an Enterprise Bear in Mind:

1. Production of feeders maximizes the use of roughage but is the least intensive form of production, and is suited only to non-arable grazing land.

2. Farm production and finishing utilizes considerable grain, but usually must depend on the breeding herd utilizing non-arable pasture land.

3. Buying and finishing steers either in the feedlot or by grass and grain will maximize the use of grain and is the only form of commercial enterprise likely to produce satisfactory returns from high priced arable land.

Separation by age, size and sex provides for maximum production and utilization of feed. Each class of cattle should be fed according to its particular needs (See table 1, page **99** and principles of nutrition (pages **94** to **96**).

Calves dropped early — at least 90 days before cows are turned on grass make the best use of their dam's milk and will be heavier on an age basis at weaning. Breed to calve in early March, only if facilities and labor are available to accommodate calving under adverse weather conditions.

Provide timely care and attention at calving — Calves may require Vitamin A supplementation if their dams have been on deficient rations. It is much cheaper to supplement the dam's ration and avoid this situation (see page **99**).

Dehorn early — Recommended methods are:

1. Birth to two weeks (best time) — **Caustic** paste or pencil.
2. Birth to six weeks—electric dehorner.
3. Two to three months—tube dehorner or knife and caustic pencil.

Castrate early—Calves may be castrated at birth and should be castrated before they are three months. The knife is the only sure instrument for all ages. If the Burdizzo is used IT MUST BE USED WITH CARE to insure that the cord is fully crushed. This will avoid staggy steers.

Give timely attention to parasite and disease control—See pages **132** and **133** for warbles and lice; page **125** for disease.

Heifers bred as yearlings if well grown will have greater life-time production than those bred as two-year olds. The rigorous nature of winter conditions and lack of adequate feed or calving facilities may necessitate delaying breeding until heifers are two-year olds.

Breeding bulls should be well exercised and conditioned but not over-fat when they are put with the herd. Do not use until fifteen months of age and then only on a limited number of cows (15-20). The number of cows per bull during a normal breeding season is somewhat dependent on the nature of the area and the management of the herd. The following is a guide:

Hand mating, 60.

Farm pastures, 40.

Open range, 30.

Rough range and bush, 20.

Housing—Brush shelters, deep coulees or board fences are usually adequate for all classes of cattle in the southern chinook area. In the northern area bush shelters and board fences will prove adequate for mature cattle; however, young stock should be afforded the protection of open front sheds.

FEEDING

Beef cattle production should be based on the maximum utilization of home grown feeds. Feed requirements and expected gains are set forth on page **99.**

Mineral supplements are required by most classes of beef cattle. Sodium chloride (common salt), Calcium, Phosphate, Iodine and Cobalt are the only minerals likely to be deficient. Place a 50-50 mixture of salt, and either bone meal or dicalcium phosphate before cattle fed mainly hay or pasture. In addition have iodized-cobaltized salt available free choice. The only place for ground limestone in mineral mixtures for beef cattle is when they are on heavy grain feeding. See page **95.**

Vitamin A is the only vitamin likely to be lacking. Supplementation will be necessary when animals have been on grain and weathered roughages for extended periods (4 to 5 months). See "Vitamins" page **96.**

FEED REQUIREMENTS, EXPECTED GAINS AND RATIONS FOR WINTERING AND FINISHING BEEF CATTLE

		Wintering Cow Herd		Wintering Calves	Finishing Calves		Finishing Yearlings	
		Farm	Range		Heifers	Steers	Heifers	Steers
Total (lb.)	Grain	Nil	Depends on Winter	300 - 400	1500 - 2000	1500 - 2000	1500 - 2400	1500 - 2400
Feed	Roughage	4000	Range — Have an Emergency Feed Supply	2000	1200 - 1800	1200 - 1800	700 - 1800	700 - 1800
Length of Feeding (days)		200		200	160 - 200	180 - 220	100 - 140	120 - 160
Gain (lb.)	Daily	Nil		.75	1.8	2.0	2.1	2.3
(lb.)	Complete			150	300 - 400	400 - 500	200 - 300	250 - 350

Rations and Special Problems
(also see principles of nutrition page 94 to 96.)

Cows can be expected to lose some weight, if their condition in the fall is good; however, if they receive a ration deficient in protein, vitimins or minerals, general health and reproductive ability may decline. Calves on adequate maintenance rations will make compensatory gains later. Winter rations should consist primarily of roughages but calves will require some grain when weather conditions are severe. Cows require about 2 lbs. and calves about 2.5 lbs. of feed per 100 lbs. of body weight for maintenance. Good quality roughage with some legume is preferred. Poor quality roughage is satisfactory if properly supplemented. Cattle entirely on roughage need mineral supplements. Feed bonemeal or other sources of calcium and phosphorous free choice.

To ensure good health and to guard against Vitamin A deficiency in newly born calves, pregnant cows on a poor quality roughage ration should be supplemented with 20,000 to 25,000 I.U. of stabilized Vitamin A and 1½ to 2 lbs. of a high protein concentrate per head per day. Wintering calves will require a similar amount of protein and 10,000 I.U. of stabilized Vitamin A per day if roughage quality is poor. Cattle grazing on winter ranges may require supplemental feed. The above supplement in pellet form is satisfactory. Heifers under three years and cows over eight to nine years frequently cannot withstand the rigors of winter grazing without extra roughage.

Wheat, oats and barley are the grains fed to feedlot cattle. The feeding value of screenings and of low grade grains resulting from drought, rust and frost is a direct function of their weight per bushel and they should be fed accordingly. At the start of the feeding period, a bulky ration of about ½ oats and ½ barley or wheat plus full access to roughage will safeguard against digestive upsets. As the feeding period progresses increase the portions of barley and or wheat and reduce the allowance of oats and hay. Cattle should be placed on feed slowly; start with 2-3 lbs. of grain daily and increase by ½ lb. daily up to 7-8 lbs. Further increase should be made carefully as warranted by appetites. Cattle can usually be brought to self feeding in 20 to 30 days. Calves on full feed will consume 10 to 14 lbs. of grain and 4-5 lbs. of roughage; while long yearlings will consume 20 to 25 lbs. of grain and 4-6 lbs. of roughage.

Feedlot cattle need a mineral supplement. Since rations are high in grain, calcium is in greater need than is phosphorous. A mixture of ½ bonemeal and ½ limestone is satisfactory if the portion of grain is moderate. On rations high in grain a mixture of ½ limestone and ½ salt, if roughage is a non-legume — if roughage is a legume feed only salt. If roughage quality is poor, feed a lb. per head per day of a high protein concentrate and feed 10,000 I.U. of stabilized Vitamin A after the feeding period has extended over 4 months. When cattle are allowed to self feed, cutting the roughage and mixing it with the concentrate will reduce the likeliness of animals going off feed particularly when the weather changes. During the cold weather, cattle will increase their consumption of grain, and if consumption is not restricted when the weather warms, scouring may result.

Salt and Water

All beef cattle should have free access to salt and water. Feed cobalt-iodized salt to guard against cobalt and iodine deficiencies. Remove the chill from drinking water in the winter and locate the water tank in an area sheltered from the wind.

Protein supplements are necessary only when roughage and grain quality are poor. See "Protein" page **95.**

Silage can constitute the entire roughage ration for any class of beef cattle. If cut at the right stage and well cured it is a palatable and nutritious feed. It is a high moisture feed and in severe weather stock may not eat enough to meet their energy requirements. In such instances supplemental feeding with grain or hay may be necessary. Three pounds of silage is equivalent to one pound of hay.

Rolled or coarsely ground concentrates are most suitable for beef cattle. Calves may be fed whole oats.

Pelleting or cutting feeds for beef cattle is justified only where savings in waste, handling by mechanical equipment, and storage are sufficient to more than offset the additional cost.

Creep fed calves will be heavier at weaning. Creep feeding is not sound if calves are to be roughed through the winter or finished to weights in excess of 1,000 pounds. Suitable creep mixtures are half oats and half barley or all oats.

Sex hormones are used to increase growth and improve feed efficiency of feeder cattle. They should not be administered to breeding stock. Administer to feeder stock according to manufacturer's instructions.

Antibiotics—Their overall value is not clear. They appear to be of real value in reducing scours in calves and may be of special value in the feedlot when the animal is subjected to stress.

Tranquilizers have been variously reported to produce nil to significant improvement in rate and efficiency of gain and reduction in shrink of cattle in transit. At the time of writing tranquilizers have not been authorized for use as feed additives in Canada and no recommendation can be offered.

BREEDING AND SELECTION

The beef industry of Alberta is based on Aberdeen Angus, Hereford and Shorthorn cattle.

In herds of sufficient size to permit practical application, cross breeding can result in heavier weaning weights and growthier feeders, and the crossbred female may be a hardier and superior mother. This is true only if good parent stock is used. Seek scientific advice regarding your specific conditions.

Selection of beef cattle should be based on:

1. reproductive ability (longevity, physical soundness, regularity of breeding).
2. growth rate.
3. conformation.

Evaluate reproductive ability by keeping a herd book record which shows breeding and reproductive performance. This means cows and calves must be identified. Identify at birth.

Use a scale to evaluate growth rate and conformation to evaluate TYPE. The nearer evaluation is made to the end product — a finished beef animal — the more accurate it will be as a criterion. Recommended times to weigh and evaluate type include:

1. weaning.
2. yearling or finished baby beef.
3. long yearlings (off grass in the fall).
4. finished long yearling bulls.

Cull parental stock if their progeny consistently give below average performance. SELECT FOR HERD REPLACEMENT those individuals that perform above the average and those from parents which consistently produce offspring with above average performance.

Any producer interested in adopting a system of selection based on performance should consult the Provincial Department of Agriculture for details of the Federal-Provincial Record of Performance program for beef cattle.

Further references on beef cattle production and feeding.

REFERENCES :

University of Alberta.
Bul. 57—Cattle Finishing in Alberta.

Department of Agriculture, Ottawa.
Feedlot Finishing of Cattle and Sheep in the Irrigated Areas of Southern Alberta.
Plans—Beef Cattle Housing and Equipment.
Pub. 955—Feeding Grass Silage to Beef Cattle.

DAIRY CATTLE

A high producing herd is basic to a successful dairy enterprise. Every individual planning to establish a dairy herd should consider:

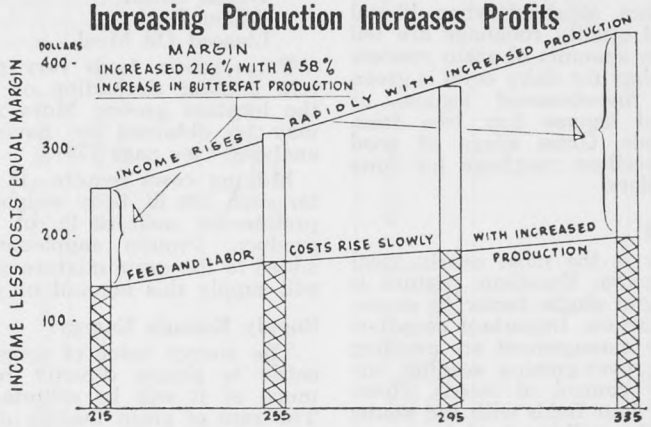
1. Milk markets available.
2. Availability and opportunity for disposal of breeding stock.

A dairy herd may be maintained by purchase of all dairy stock or by breeding and raising replacements. The latter is recommended under most Alberta conditions.

Breeding and Selection

1. Use only purebred bulls or semen of bulls out of known high-producing ancestors. Good bulls can nearly double herd production in two generations.

2. Keep annual records of milk and butterfat production on every animal.
3. Cull low producers. Don't keep cows — make them keep you!
4. Retain heifers from cows that are regular breeders and high producers of milk and butterfat.
5. Large cows with strong frames, large barrels and large well attached udders produce the most milk.



Based on 1949 to 1954 data for Edmonton and Calgary milk sheds. Obtained from Dairy Cost and Farm Management Services, Alberta Department of Agriculture.

FEEDING

Yearly Feed Requirements

Successful dairymen grow most of the pasture and other feeds required.

The following information is based upon a yearly requirement of an average cow weighing 1,200 pounds and producing 4% milk.

Roughage

Three tons, plus adequate grazing during the pasture season. Three pounds silage is equivalent to 1 pound hay.

Concentrates

Level of Production Pounds Milk per cow	Grain required with summer pasture (no supplement)	Grain required with winter feeding (no supplement needed with hay over 12% protein)	Amounts of a 24% protein supplement that should be included as a portion of the grain when a mixed hay or a grass or cereal hay (oat bundles) is fed.	
			10 - 12% Protein hay	Under 10% Protein hay
6,000	200 lb.	1,200 lb.	175 lb.	400 lb.
8,000	500 lb.	1,800 lb.	280 lb.	650 lb.
10,000	800 lb.	2,500 lb.	370 lb.	850 lb.
12,000	1,100 lb.	3,200 lb.	475 lb.	1,100 lb.

Example: Cows with yearly production of 8,000 lb. milk being fed brome hay would require a total of 1,800 lb. concentrate mixture composed of 1,150 lb. grain and 650 lb. protein supplement during the winter feeding period, plus the 500 lb. grain required during the pasture season.
Note: The 24% protein supplement can consist of 60% wheat bran and 40% linseed meal.

Where the majority of the cows calve in the spring less protein supplement will be required, and there will be a larger proportion of the total grain fed on pasture.

Minerals

40 to 60 pounds cobaltized-iodized salt (blue salt) per cow per year. Add 1% bone meal to the grain mixture for high-producing cows.

Pasture

2 to 2½ acres cultivated pasture in high productive areas with good soil and ample rainfall.

3½ to 4 acres cultivated pasture in medium productive areas with only fair soil and rainfall.

1 acre of good irrigated pasture.

3 acres native pasture or 10 acres bush land equal 1 acre cultivated pasture.

Minimum pasture requirements should be provided only when good management and rotational grazing are to be followed. (See section on forage crops — Page 47).

Bedding

1,800 pounds per cow per year in a stanchion barn. 3,100 pounds per cow per year in a loose housing barn.

Young Stock Requirements

Calves: Milk 1,000 pounds (¼ whole milk and ¾ skim milk). Grain — 1,200 pounds. See page 103.

Hay — 2,000 pounds. Pasture—from four months on.

Yearlings: Hay 4,000 pounds. Grain 1,000 pounds. Pasture—as for milking herd.

Winter Feeding

Best results are obtained when liberal amounts of good quality roughage are fed rather than large amounts of grain concentrates. The best hay for dairy cows is green colored, leafy, fine-stemmed legume or mixed grass and legume hay free from mould and weeds. Grass silage of good quality is an excellent roughage for cows and growing heifers.

Summer Feeding

Green pasture is the most nearly ideal feed for dairy cows. Excellent pasture is the most important single factor in economical milk production. Important considerations in pasture management are avoiding too early grazing, over-grazing, seeding, fertilizing and the control of weeds. Rotational grazing of four fields with the young stock following the milking herd is recommended.

Balance Rations for Protein!

The approximate protein content of feeds commonly used in Alberta are indicated in the following table.

Alfalfa Hay	14%
Clover Hay	12%
Grass Hay	8%
Cereal Hay (greenfeed)	6%
Oat Grain	10%
Barley Grain	10%
Wheat Grain	13%
Wheat Bran	16%
Linseed Oil Meal	35%

Farm grown feeds vary greatly in protein content depending on the year and the location grown. More reliable figures may be obtained by having your feeds analyzed (see page 179).

Milking cows require .11 lb. of protein for each 100 lb. body weight and .7 lb. of protein for each 10 lb. of 4% milk they produce. Protein supplement should be added to the grain mixture at a level which will supply this amount of protein.

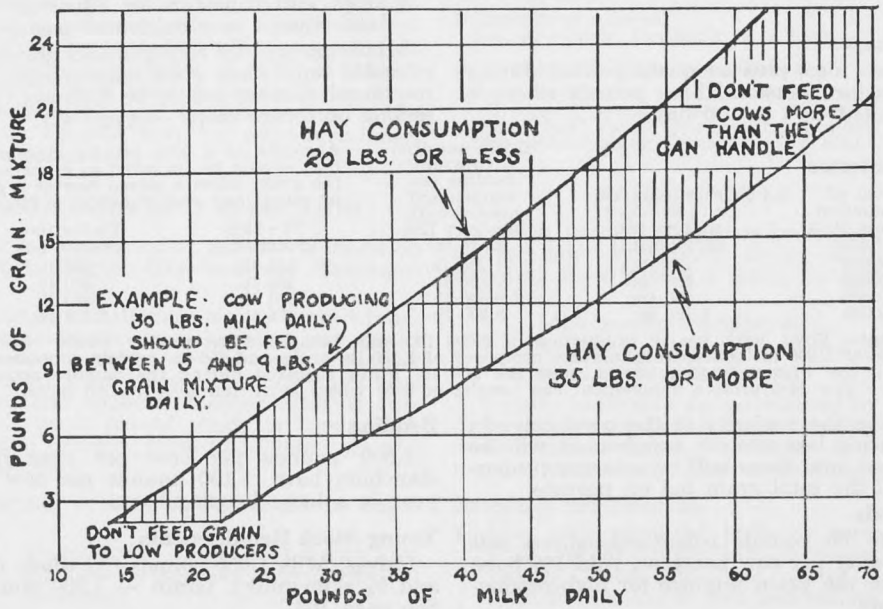
Supply Enough Energy!

The energy value of roughage for dairy cattle is almost directly related to how much of it will be voluntarily consumed. The rate of grain feeding depends largely on the amount of hay eaten.

Measure the amount of hay eaten and then feed a grain mixture (balanced for protein) according to Table 1 below. Use the higher rates when only about 20 lb. per day of hay is consumed and the lower rates when cattle eat about 35 lb. per day.

FEEDING CHART FOR GRAIN MIXTURES

FEED GRAIN MIXTURE ACCORDING TO MILK PRODUCED



FEEDING SCHEDULE FOR CALVES
TABLE 2

	Colostrum	Whole Milk	Skim Milk	Milk Replacer	Calf Starter	Grain Mixture
(1) Fluid Milk Producer with some surplus or Manufacturing milk producer	1st 3 days	250 lb. total 1st 4 - 6 weeks in decreasing amounts per day	—	—	4 - 6 weeks to 4 months free choice	4 months to 1 year - 3 -4 lb. per day
(2) Fluid Milk Producer with little surplus	1st 3 days	150 lb. total 1st 3 - 4 weeks in decreasing amounts per day	—	—	3 - 4 weeks to 4 months free choice	same
(3) or	1st 3 days	—	—	As directed by Manufacturers 1st 4-6 weeks	same as (1)	same
(4) Churning cream shipper with excess skim milk	1st 3 days	—	10 - 12 lb. per day to 4 mo.	—	—	From 6 weeks to 4 mo. Full feed 4 mo| to 1 year 3-4 lb./ day

Note: — (a) Calf starter should be given during the last 10 - 14 days that calves are receiving milk or milk replacer. Calves may be weaned when they are readily consuming the starter.

(b) Calves should receive excellent hay or good, parasite-free pasture.

Challenge the Cow!

Producers with high quality cattle are often able to increase production per cow by offering more grain to good cows than is indicated by the amount of milk they are presently producing. Many cows will increase production in response to this added feeding. Continue to increase grain allowances until no more increase in production is obtained. Do not over-feed cows which do not respond.

Feeding Dairy Calves

Every calf must receive colostrum for the first 2 or 3 days. The feeding system used after this depends on the economic conditions and the preference of the producer. Certain feeds are available.

1. Milk replacers—these products replace whole or skim milk. They are fed mixed with water in the same way that milk is fed.
2. Calf starter or calf meal—this is fed as a dry meal usually immediately after the calf has been weaned from milk or milk replacer.
3. Calf grain mixture—should be fed when calves receive a liberal amount of skim milk or when older calves have begun to eat considerable roughage or grain.

Suggested feeding schedules are in Table 2 page **103.**

WHEN ARE MINERALS REQUIRED?

Salt—Provide access to a salt box outside. Add 1% salt to the concentrate mixture to ensure that heavy producing cows consume sufficient salt.

Iodine—Feed iodized salt.

Calcium is lacking in grass, cereal hays and grain. Plentiful in legumes.

Phosphorus is lacking when only roughages are being fed. Grains are rich in phosphorus. For heavy producers and growing heifers feed a supplement rich in both calcium and phosphorus, such as bone meal.

Cobalt—When only non-legume hays are fed the ration may be deficient in cobalt. Cobaltized-iodized salt (blue salt) is recommended. See page **98.**

MANAGEMENT

The managerial ability of the dairyman may mean the difference between success or failure.

Housing—Two systems of dairy cattle housing are in common use:

1. Stall or stanchion.

2. Loose housing with separate milking room. For comparative information on the two systems see reference 1.

Dairy Bull — Keep the bull in separate quarters. A bull corral with a separate breeding stall is recommended. Exercising of the bull is important. Light service at 10 to 12 months of age is possible. Maintain the bull in a thrifty condition. Do not allow him to become excessively fat or thin.

Dairy Heifer — Young cattle should be kept in a good growing condition and making normal gains. Heifers that are well grown for age can be bred earlier than those that are underdeveloped.

Age to Breed

Breed	In Months
Holstein	18 - 21
Ayrshire	17 - 20
Guernsey	16 - 19
Jersey	15 - 18

Calving Time—Cows require a dry period of at least six weeks to restore body reserves for the following lactation period. Following calving do not breed back for 60 days. Special care at calving includes:

1. Isolation in clean, well-bedded pen several days before due.
2. Feed limited quantities of feed that are laxative and fairly rich in protein, such as bran mashes.
3. Give aid only when necessary. Call veterinarian if condition is serious.
4. Allow cow to lick calf. Be sure fetal covering, is removed immediately from calf's nostrils to allow breathing.
5. Offer cow lukewarm water to drink.
6. Continue feeding bran mashes for at least 24 hours.
7. Be positive cow has dropped afterbirth. Negligence here may ruin the cow.
8. Gradually increase concentrate allowance to required amount as congestion in udder subsides.
9. Observe closely for possible signs of ketosis or milk fever.

REFERENCES

Department of Agriculture, Edmonton.
Pub. 7—Dairy Barns for Alberta.
University of Alberta, Edmonton.
Bulletin 41—Care and Feeding Dairy Cattle.
Dairy Cattle Barn Sheet.
Dept. of Agriculture, Ottawa.
Dairy Cattle Housing and Equipment.

SHEEP

The Alberta sheep industry is roughly divided into two main divisions, range and farm flocks. An economical range flock should contain a minimum of five hundred ewes. Farm flocks of less than forty ewes are of doubtful economic value and may range from that number up to two hundred ewes for maximum economy. Persons with little or no experience should start with a smaller number but plan to increase to these numbers.

When starting it is common practice to purchase five or six year old range ewes but it is recommended that an operator purchase: (1) ewes under four years of age; (2) the larger ewe lambs out of feedlots in early March, or (3) feeder lambs and retain the best ewe lambs for breeding

in the following fall. Competent assistance is essential to make careful selections of aged ewes otherwise heavy losses will offset any advantage in price.

Range flocks are basically of Rambouillet breeding to maintain high wool quality and the "banding" instinct.

The popular farm breeds are Suffolk and Hampshire, with more recent introduction of white faced breeds, North Country Cheviot, Corriedales, Romnelets and Columbias for crossing purposes.

FENCING

For active breeds such as Suffolk, Border Cheviot or North Country Cheviot, it is advisable to use 30" page wire topped with two strands of barbed wire. For more docile breeds five or six strands of barbed wire on posts one rod apart is adequate.

EQUIPMENT

Equipment does not need to be elaborate or expensive. A high fence made up of slabs with an open sloped-roof shed 20' - 24' deep across the north end of the corral is sufficient. Allow approximately fifteen square feet of shed and twenty-five square feet of corral space per ewe. A cheaply constructed lambing shed adjacent to the corral shed with artificial heat is required. Provide ten 4'x5' claiming pens for each fifty ewes. Confine the ewe and new born lamb in a claiming pen until the lamb is strong and nursing well. They may then be removed and penned with other nursing ewes. Where electrical power is available "lamb creeps" may be built with 4'x8' panels with heat bulbs suspended at safe heights — such creeps may also be used to start lambs on creep feed of choice alfalfa and whole oats.

Sheds should be on high, well drained ground with southern exposure. Clean corrals and sheds as soon as sheep are turned out on pasture. Frequent summer use of wintering quarters is **not recommended** if sheep parasites and diseases are to be kept to a minimum.

PURE BREEDING

Those desiring to enter this field should first gain experience in the breeding, feeding and general management of a grade flock. Careful selection of foundation animals for size, uniformity, evidence of early maturity, clean dense fleeces and true type for the breed may avoid great disappointment later. Do not select on the basis of fancy pedigrees alone.

TESTING PROGENY OR PERFORMANCE

Testing of either pure bred or grade flocks provides the information necessary for selection of replacement females from parents that consistently leave strong, fast gaining, early maturing lambs. Consult local District Agriculturist or Alberta Department of Agriculture for detail information and necessary forms.

BREEDING PRACTICES

In smaller farm flocks pure bred ram lambs born January to March may be used for breeding in late fall. Very early ewe lambs may be bred in December; their progeny should not be kept for replacements. Under range conditions the use of mature rams and ewes is recommended. Mature rams may serve 40 to 60 ewes whereas ram lambs should not be used on more than 15 to 20 ewes. To ascertain ram fertility and breeding progress apply ochre (or some other washable coloring) on the breast of the ram. Ewes will be color-marked on the rumps as they are bred. Change color every sixteen to eighteen days; if too many ewes are marked by second and third services change rams.

In range flocks a percentage of Suffolk or Hampshire rams may be used for production of earlier maturing cross-bred market lambs. Retain only those ewe lambs sired by white-faced rams for flock replacements. If circumstances permit, a better practice for the production of replacement ewes is to run a separate band of selected white-faced ewes and rams. The balance of the ewe flock may be mated to black faced rams for production of market lambs.

On the range ewes are bred to lamb in April or May. Under farm conditions where adequate shelter and lambing equipment are available, it is advisable to lamb as early as January or February. Early lambs are usually ready for market when prices are high. To obtain a high percentage of twin lambs ewes should be "flushed" on good pasture, or fed one-half to one pound of oats daily for three weeks before breeding.

Cross, or rotational breeding is recommended in farm flocks with only the best ewe lambs retained for breeding. These should always be mated to pure bred rams of a breed carefully selected to follow on the breeds already used. To grade up a sheep flock retain the best ewe lambs for breeding purposes; use unrelated rams of the same breed from year to year.

LAMBING PERIOD

Lambing areas must be dry and well bedded. Crutch ewes by removing wool and dung locks from around the hind quarters and udders three to four weeks before lambing to facilitate nursing and prevent lambs from swallowing wool balls. Separate ewes due to lamb within a few days and bring into lambing quarters for the night, especially so, when weather is cold in late winter or early spring. Make full use of claiming pens. Good feed and ample drinking water should be given ewes after lambing.

Lambs may be docked with a jack-knife before a week of age. Older lambs should be

docked with hot iron or "Burdizzo." Rubber rings are not recommended. If knife is used to castrate at two or three weeks of age, carefully disinfect before and after castration. If "Burdizzo" is used crush left and right cords separately.

Start creep feeding lambs early on whole oats.

ORPHAN LAMBS

If at all possible, get a milking ewe to adopt the orphan lamb. This may be accomplished by smearing the "cleanings" from a ewe that has lost her lamb, or a ewe with one lamb only, over the orphan. Special attention may be necessary to see that the orphan nurses. If hand feeding is necessary the following procedure is suggested.

In the first two days, feed two to four tablespoons of milk from a high butterfat test cow five or six times in each 24-hour period. Add a few drops of concentrated cod liver oil to each feeding. Warm bottled milk in hot water to 100°F., use clean bottle and nipple for each feeding. Gradually reduce number of feedings to twice daily. Increase quantity at each feeding and allow lambs access to a creep feed.

PASTURE AND FEED REQUIREMENTS FOR SHEEP AND LAMBS

Ewe & Lamb	Acres Pasture - head Central Alta. 0.5 to 1.5		Acres Pasture Northern Alta. 0.3 to 1.0	Acres Irrigated Pasture 0.1 to 0.2
	Hay	Straw	Grain	Linseed Meal
Breeding ewe (during winter)	1,000 lb.	some	150	10 lb.
Lambs-fattening	200 lb.	some	180	15 lb.

It is essential to provide plenty of pasture for sheep, however, legume pastures are not recommended because of bloat danger. Five ewes equal pasture requirement of one cow. To increase carrying capacity on seeded pastures and to eliminate worm infestation, not less than two, and preferably three pasture fields should be established and used for rational grazing at three-week intervals.

Winter Feeding—Ewes require four to five pounds daily of good quality hay, preferably a mixture of legume and grass. Three to five pounds of silage can be fed with liberal hay feedings — or as part of the roughage allowance. Silage alone is not recommended. Green oat bundles may be used only sparingly. If ewes are thin, ½ to 1 pound of whole oats should be fed per ewe daily during the last two months of pregnancy. If hay is of poor quality one part of linseed meal should be added to four or five parts of oats.

Mineral Mixture—of 50 lb. blue iodized-cobaltized salt and 50 lb. bone meal or dicalcium phosphate should be self-fed to all sheep; in addition, blue salt should be provided in block or loose form in the winter as well as during pasture season.

Water—Remove chill. Drinking openings should be small.

Ewes must have ample opportunity for daily exercise. They must not be housed in totally enclosed warm quarters, except when lambing. Locating feed racks at least two hundred yards from the bedding area will enforce needed exercise.

Lamb Feeding — Feedlot lambs require very little protection other than a good windbreak. A good supply of water with chill removed is essential. Start lambs on good quality hay or legume-hay mixture and about one-tenth lb. of whole oats per day per lamb. If quality of hay is poor, add 10% of linseed meal pellets to grain. Gradually bring lambs to full grain feed of up to two pounds per day in eight weeks. As the feeding period progresses, part of oats is replaced with barley. Grain should not be ground. Feeder lambs should have access to blue salt at all times. Self-feed some mineral mixture as recommended for wintering ewes. Lambs should be finished and marketed when approximately 100 lb. in weight. Under good hand feeding conditions, 100 pounds of gain may be expected on approximately 400 pounds of hay and 475 pounds of grain.

SHEARING

This is done by hand or power shears, usually in late May after danger of cold storms has passed. Sheep must be dry or wool will mold in the bags. The best shearing is done on hot days when grease rises in the wool. Use shearing platforms to keep wool clean and in one piece. Short, taggy, belly wool, black, and leg wool should be packed separately. A wire mesh or slatted 4'x8' table should be used for wool preparation. Spread the fleece weather side up on the table, take out undesirable parts; fold one-third in from each side and roll from breech-end to neck and tie with paper string. **Never** use binder twine. Pack the fleeces tightly in bags obtainable from the Wool Growers Association or Wool Buyer.

PARASITES

Parasites must be controlled if the flock is to be thrifty and productive. The main external parasite is the sheep tick or ked. The entire flock should be thoroughly sprayed or dipped about a week after shearing. In badly infested flocks it may be advisable to dip or spray again in the fall before cool weather sets in. Toxaphene, Lindane, D.D.T. and other suitable preparations are available from drug stores, wool handlers and live stock supply houses.

Internal parasites or worms can be well controlled by rotational grazing and the use of worm expellant preparations. Phenothiazine in fine powder form in liquid suspension is highly recommended. It is also obtainable and may be used in bolus form. Where pastures are not rotated all sheep should be treated for worms before turned out to pasture. Ewes should not be treated less than one month before lambing or sooner than a week after lambing.

For further details and alternate treatments see reference 1 and 6.

SHEEP IMPROVEMENT POLICIES

The Federal and Provincial Departments of Agriculture operate policies designed to assist commercial producers to obtain rams. Details can be obtained from the District Agriculturist.

REFERENCES :

University of Alberta, Edmonton.
Bulletin 52—Sheep Production in Alberta.
Department of Agriculture, Edmonton.
Sheep Housing Equipment Catalogue.
Department of Agriculture, Ottawa.
Bulletin 906 — Wool Production in Canada.
Bulletin 886 — Range Sheep Production in Canada.
Bulletin 786 — Feedlot Finishing of Cattle and Sheep.
Bulletin 904 — Sheep Diseases in Canada.

HORSES

Even though the use of horses has been drastically reduced in recent years, there are still farm and ranch chores for which the horse remains the most economic source of power and transportation.

In their restricted use, it is more important than ever that horses be sound. Many defects are inherited but failure to care for feet, legs and teeth also will lead to unsoundness.

FEEDING

From 1 to 1¼ pounds of roughage and ¾ to 1 pound of grain daily for each 100 pounds live weight are recommended for working horses. Reduce the grain on light work or when idle. Oats are the standard grain for horses although the addition of bran improves the ration. Grass hays are preferred but mixed can be used.

In-foal mares need daily exercise and extra minerals. Keep a mixture of equal parts salt, limestone and bonemeal available to them at all times and starting in the fall, give a half-teaspoonful of potassium iodide in the feed or water every ten days up to foaling.

THE ORPHAN FOAL

Milk from a fresh cow, low in butterfat, should be used. Make up a mixture of a pint of such milk with a tablespoonful of sugar (dissolved in water) and from three to five tablespoonfuls of lime water. Warm to body temperature and feed about a fourth of a pint every hour from a bottle with a nipple. Reduce the number of feedings in a few days and teach the foal to drink as soon as possible. Lime water can be made by dissolving unslaked lime in water, allowing to stand for several hours and pouring off and using the clear liquid.

REFERENCES :

Ontario Department of Agriculture, Toronto.
Horses, Bul. 506.

SWINE

ECONOMIC RETURNS

Swine make a significant contribution to Alberta farm economy. With average annual marketings during the past five years of over 1,750,000 pigs, valued at nearly $70 million, Alberta ranks second to Ontario in pig production.

Carcass quality is of particular importance as the consumer demands a lean product. This requirement is not being met by the majority of Alberta pigs, although the grades have improved during recent years. The average price differential of $6.50 between a grade A and C hog can easily represent the difference between profit and loss. Fat hogs are not cheaper to produce than lean hogs, in fact it costs more to produce fat than lean meat.

Hog production is rapidly becoming more specialized. To realize maximum returns from a commercial hog operation it is necessary to be efficient in breeding, feeding, management and marketing.

BREEDS AND BREEDING

The principles of selection and breeding in livestock are discussed on page 93. Certain breeds are inherently more suitable for the production of high quality carcasses than others, but there are good and bad individuals within all breeds. Breeding stock should be selected with due consideration to records of performance.

Bacon breeds available in Alberta are the Yorkshire, Lacombe, Landrace, Tamworth and Berkshire. The former three breeds are white in color and have, on the average, desirable carcass characteristics. They probably are the best breeds to use either in a purebred operation or in a grade or crossbreeding program. The colored breeds provide greater resistance to sun-

scald, an important consideration when pastures are used. On the average the Tamworth and Berkshire do not yield as desirable carcasses as the other three breeds mentioned. Carcasses showing pigmentation cannot grade higher than B. New breeds and inbred lines of meat type hogs have been developed in the United States and Europe but these cannot be recommended until they have been adequately tested in Canada.

FEEDING

The principles of nutrition outlined on page **94** apply to pigs. For details on feeding and management see references on page **110.**

Pigs fed balanced rations require 600 to 750 lb. feed from weaning to market. A sow requires 2,500 to 3,000 lb. of feed per year and this must be charged against her pigs. This figure emphasizes the importance of marketing large litters and getting two litters per year from a sow.

Grains form the basis of hog feeding in Alberta. Table 1 outlines suggested mixtures of grain and a complete protein-mineral-vitamin supplement or "35 to 40% commercial hog concentrate" which is usually the feasible method of balancing rations.

TABLE 1
Suggested Rations for Swine

Type of ration	Preweaning	May be combined Starter	May be combined grower	Finisher	Sows*** Prenancy	Sows*** Lactation
Weight of pigs ..lb.	10-40	40-75	75-110	110-200		
Expected daily gain .....lb.	0.8	1.4	1.6	1.6-1.8	1.0 gilts 0.5 sows	
Average daily feed consump.* ..lb.	0.5 creep 1.6 weaned	3.5	5.0	6.5	6.0	12-16
Barley and/or wheat .....%	Complete	50-85	50-85	42-72	18-38	38-63
Oats .....%	Commercial	0-25**	0-25	20-40	40-50	25-50
Alfalfa meal or hay .....%	mixed ration	0	0-10	0-10	10-30	——
35 to 40% Concentrate .....%	recom'd.	15-18	12	8	12-15	12-15

* On good pasture, feed intake of pregnant sow should be restricted to one-half this level.
** Oat groats may be fed at much higher levels in the starting period.
*** Boars should be fed similarly to pregnant sows with an increase in feed when breeding.

METHODS OF FEEDING

Self-feeding of market hogs is generally recommended because of low labor requirements. Restricted feeding of finishing pigs will reduce the rate of gain but may improve feed efficiency and carcass grades. Self-feeding may produce comparable grading results to restricted feeding if the ration is diluted with fibrous feeds such as oats or alfalfa meal, but efficiency of feed utilization will not be as good as when a higher energy ration is fed. Sows should normally be hand-fed so that consumption can be controlled. A very bulky ration such as 25-30% ground alfalfa is required if sows are self-fed.

SUPPLEMENTAL FEEDS

PROTEIN

In a protein supplement for pigs the quality of protein is as important as the quantity. Proteins are built up of over 20 amino acids, 10 of which are essential for the pig, and it is the presence of the proper proportion of amino acids that makes some protein supplements more valuable than others. Vegetable oilcake meals, animal and fish by-products are the main sources of protein in commercial supplements. Skimmilk or buttermilk, if fed as recommended in Table 2, will replace other protein supplements, but will not supply all the necessary minerals and vitamins.

TABLE 2
Skimmilk and Undiluted Buttermilk for Pigs

Weight of pigs	Lb. skimmilk or buttermilk per lb. of grain
Weaning to 75 lb.	2.5
75-110 lb.	2.0
110 lb.-market weight	1.0
Sows	Free choice

Commercial protein-mineral-vitamin supplements are fortified with minerals, vitamins and antibiotics to meet the requirements of pigs as outlined below.

Pigs require 0.5 lb. iodized salt and 0.5 lb. ground limestone per 100 lb. total ration or free-choice access to a mixture of these minerals. In addition, pigs require 50 to 100

p.p.m. of zinc in the ration to prevent the possible development of parakeratosis, a disease of the skin accompanied by severe dermatosis (scurfiness) and unthriftiness. This disease usually occurs shortly after weaning. Zinc oxide, zinc sulfate or zinc carbonate at levels of 1/3 lb., ¾ lb. and ½ lb. respectively per ton of complete ration will combat this condition.

In addition to vitamin A (1,000,000 I.U. for market pigs and 2,500,000 I.U. for breeding stock per ton of ration) and vitamin D (200,000 I.U. per ton of ration) it is advisable that riboflavin, niacin, calcium pantothenate and vitamin B_{12} be included in rations of young growing pigs to meet conditions of stress that may occur. Ten grams of antibiotic per ton of feed for growing hogs and 25-50 gm. per ton in creep feed and starter rations are desirable.

PASTURE

Pasture is recommended for sows and prospective herd gilts and boars but not for growing pigs if balanced rations are fed. Pasture may reduce labor requirements, provide more sanitary conditions and allow market pigs to balance their rations but it will decrease rate of gain and perhaps feed efficiency as compared to indoor rearing. An acre of good pasture will carry 10 sows, or three to five sows with litters. Annual cereal pastures are recommended for reasons of sanitation. The choice of pasture type is secondary to providing green forage for the entire growing season.

WATER

A pig requires about 2.5 lb. of liquid for each pound of solid feed. Water should be available to pigs at all times, preferably by automatic waterers, and it must be kept ice-free in winter.

MANAGEMENT

Principles of Livestock Management are given on page **96.**

Sows should be flushed by placing on full feed one week before breeding until about three weeks after breeding. Then reduce feed to 4-6 lb. per day or 2-3 lb. per day if on pasture and increase to 6-8 lb. about one month prior to farrowing. Individual feeding of sows should be considered.

Care at farrowing time is extremely important as this is when the heaviest pig losses occur.

Gestation period — 112 to 115 days; or 3 months, 3 weeks and 3 days. Move sow into farrowing quarters one week before farrowing date.

Important Points at Farrowing Time

(a) Warm farrowing quarters — artificial heat required.

(b) Clean and disinfect pen or stall (1 lb. lye to 30 gal. hot water or recommended disinfectants).

(c) If weather permits, thoroughly wash udder and preferably the entire sow.

(d) A guard rail 8 inches from floor and 8 inches from wall, or use farrowing stalls.

(e) Avoid coarse straw and use a minimum amount of bedding.

(f) Be present when sow is farrowing.

(g) Remove "black teeth" with sharp nippers. Do not injure gums.

(h) Birth of hairless pigs indicates iodine deficiency.

(i) Birth of weak litters usually indicates lack of protein, minerals or vitamins in sow ration.

(j) Failure of sow to milk may be caused by: Ration imbalance during pregnancy, frequently a lack of protein and/or pasture. Too concentrated a ration prior to farrowing; use bulky feeds such as bran and oats. Lack of exercise; do not keep sow in farrowing barn for a long period prior to farrowing. Inadequate water supply; give sow all the warm water she will drink. Bringing sow on feed too rapidly. A fever lasting more than a few hours will stop milk flow; treatment with 1.5 to 3 million units of penicillin may be helpful. Milk let-down can sometimes be initiated by use of a hormone injection; contact your Veterinarian.

SOW AND LITTER

(a) Prevent anemia in suckling pigs. Give an iron compound by mouth at twice weekly intervals from three days to three weeks of age or inject an irondextran compound. See page **124.**

(b) Supply creep feed beginning at one week of age. Commercial pre-weaning rations are recommended as such rations are complex. Water must be readily available to the young pigs.

(c) **Orphan pigs** may be raised if they were able to get first milk or colostrum from the dam and if a program of extreme sanitation is followed. Commercial milk replacers are most desirable but the following formula has proven useful. Warm to body temperature.

Cow's milk	1 qt.
Water	1 pt.
Sugar	1 tsp.
Antibiotic supplement	approx. 0.25 gm. of antibiotic, preferably a soluble supplement.

Place dry pre-weaning ration in the pen at one week of age. Orphan pigs are very subject to ailments, and unless a producer is willing to spend considerable time, it frequently does not pay to raise them.

(d) Early weaning. Under practical conditions 5 to 6 weeks weaning is quite feasible and will usually give as good results as 8 week weaning. Weaning at 3 weeks of age or 10 lb. in weight should be practised only

by the specialized producer who can supply superior management. Unless a producer makes use of early weaning to get more litters from his sow it offers no advantage over normal weaning.

(e) Castration — male pigs intended for slaughter should be castrated prior to six weeks of age.

FOLLOWING WEANING

Once a pig reaches 50 lb. in weight it is past the most critical stage of its life but proper feeding and management cannot be ignored. Pigs of this age are still subject to diseases and parasites. (See Veterinary Section, page **123.**)

(a) Pen area—Allow 6 sq. ft. per pig to 100 lb. and 10 sq. ft per pig to market. Do not group pigs that vary widely in weight. If a pig shows signs of unthriftiness or sickness remove to a hospital pen. Crowding of pigs often contributes to tail chewing and cannibalism.

(b) Worm treatment — (See also page **124**). Shortly after weaning treat for intestinal roundworms. Methods:

Piperazine derivatives, cadmium oxide compounds or hygramycin — To be used as directed by the manufacturer.

Sodium fluoride—Weigh the amount of feed to be fed for one day. To this add 1% by weight of sodium fluoride. This should be thoroughly mixed and must be fed dry. Pigs may be given water to drink in a separate container from the feed. Caution is advised as sodium fluoride is a poison.

(c) Market weight — To get maximum returns from hogs they should be marketed at 190 to 200 lb. liveweight to give carcasses weighing under 150 pounds. A weigh scale is recommended for all hog producers.

BUILDINGS AND EQUIPMENT

REFERENCES :

Dept. of Agriculture, Edmonton.
Swine Housing Catlogue.
Swine Equipment Plans.

University of Alberta, Edmonton.
Bull. 22 — Swine Production in Alberta.

SPECIAL FEEDING PROBLEMS

Sickness, unthriftiness, and death losses among livestock may be caused by toxic substances in the feed or drinking water. The amount of toxic material that will cause death varies considerably with the class of live stock and their condition. In general, thin animals can tolerate less toxic material than well-fed animals. Where sickness, unthriftiness, or death losses do occur a veterinarian should be consulted. The following includes the most commonly occurring problems in Alberta.

ERGOT

Grain containing more than one ergot body per thousand kernels is potentially harmful. The amount of ergot in grain can be reduced by putting it through a cleaning mill or by mixing it with non-ergotty grain. Ergot-infested hay or pasture also is dangerous.

MOLDY, HEATED AND FIRE-DAMAGED GRAIN

These are less palatable and of lower feeding value than normal grain but are usually not harmful to live stock. (Laboratory test for Toxicity not available.) Because of their lack of palatability they are not suitable feeds for heavy feeding. Moldy or heated hay is usually less palatable to stock, and of lower feed value but is seldom toxic. (see sweet clover disease.) Wood, nails and other material should be removed from fire-damaged grain before grinding or feeding it.

SMUTTY, RUSTED, SPROUTED AND FROZEN GRAINS

These are of lower bushel weights than undamaged grain. Weight of grain required per pound of gain will increase about 2% for each decrease in one pound per bushel. They are not toxic to live stock with the exception of flax (see Prussic Acid poisoning) and are usually as palatable as undamaged grain.

TREATED SEED GRAIN

Grain treated with fungicides or insecticides should not be fed to live stock as many of these compounds are very toxic. Many of the toxic ingredients are termed "accumulating poisons"—a small amount may be fed safely but the poisons accumulate and may poison the animal.

NITRATE POISONING
(Oat-Hay Poisoning)

Frost, drought, certain weed sprays, and heavy applications of high-nitrogen fertilizers may cause nitrates to accumulate in growing plants. In Alberta, oats are more often affected than other crops but wheat, barley, and some grasses also may be affected. Pasture plants, hay or straw containing over 1.0 to 1.5 per cent nitrates as KNO_3 are usually poisonous. A high nitrate content is sometimes found in certain water. (See under Water.)

PRUSSIC ACID OR HYDROCYANIC ACID POISONING

Flax that has been frozen, hailed or otherwise damaged before maturity may contain toxic amounts of prussic acid. Amounts in excess of approximately 0.02 per cent of the dry weight are dangerous. To obtain analysis see page **179.** (Feed and soil testing service.)

"SWEET CLOVER DISEASE"
(Bleeding Disease)

Improperly cured sweet clover hay or

silage may become toxic. Such damaged feed should be fed only occasionally or in limited quantities along with good roughage. It should not be fed during the latter part of pregnancy. Laboratory test for toxicity is not available.

WEED SPRAYS AND INSECTICIDES

Some of these are very toxic to live stock. The manufacturers' warnings on the container should be read carefully before using them.

GREASE, OIL, AND PAINT, ETC.

Some of the modern lubricants contain toxic ingredients, hence care is needed to prevent them geting into feeds through grinders, etc., and to prevent live stock licking machinery. Dump old paint pails, storage batteries, ashes and other garbage where animals do not have access.

POISONOUS PLANTS

There are a number of native plants poisonous to live stock. (See references.) Animals deficient in salt or other minerals eat poisonous plants more readily than animals not deficient in minerals.

WEED SEEDS

Most of the common weed seeds are not harmful to live stock in the amounts commonly found in grain. When making up less than one quarter of the total concentrate mixture ground pigweed, wild oats or buckwheat, have approximately the same feed value per pound as oats. Wormseed mustard is highly unpalatable even in small quantities and stinkweed will taint milk and meat.

WATER

Seepage from corrals, etc., may cause water to be high in nitrates. Water containing over 0.35 per cent nitrate is toxic to ruminants. Water high in mineral salts may not cause death but can cause general unthriftiness. Where the water is suspected an analysis should be obtained. This can be arranged through your District Agriculturist. Some algae or slime which grow on still water may be toxic to animals. (See Livestock Diseases, page 123.)

REFERENCES:

Dept. of Agriculture, Ottawa.
Feeding Value of Damaged Grain.
Dept. of Agriculture, Edmonton.
Pub. 38 — Weeds Poisonous to Livestock.

Dairying

ALBERTA DAIRY INDUSTRY 1961

Number of farms producing milk	44,748
Number of milk cows	287,932
Total milk prooduction, lbs.	1,721,496,000
Average milk per cow, lbs.	5,979
Farm value of milk production	$ 51,824,000
Factory value of dairy products	$ 58,608,000
Number of licensed dairy manufacturing plants	120

Milk Utilization in Percentage

Butter	58.2	Milk for Manufacturing	8.1
Fluid Milk and Cream	29.9	Fed to Farm Animals	3.8

The production of milk in Alberta is contributing an ever increasing amount towards the total farm cash income. In 1961 it amounted to $41,617,000 or 7.8% of the total. While this does not approach the proportion that dairying contributes to Canadian agriculture, which in 1961 amounted to 534 million dollars being exceeded only by the income from the sale of cattle and calves many of which originated in dairy herds, nevertheless, it has provided a steady income throughout the year and a ready market for home grown feeds and family labour.

Dairy production is concentrated in the black and grey wooded soil zones of the province.

The number of farms producing milk have decreased in recent years, however, the number of milk cows have increased and there has been a substantial increase in the milk production per cow.

Farms producing milk for the fluid market have become highly specialized with the introduction of farm bulk tanks, milking parlors, pipeline milking, and loose housing. Fluid milk receives the top price which ranges from $4.25 to $5.25 per cwt. The producers of such milk must meet strict regulations by the Health Department and maintain an even supply throughout the year which is controlled by means of a quota.

More than half the total milk produced comes from farms with 6 to 10 milk cows and is separated on farms and marketed

as churning cream for the manufacture of creamery butter. The skim milk is a valuable feed for hogs, calves and poultry. The combined value of the cream and skim milk, on the basis of 100 pounds of milk is only about half that of milk for fluid sales.

Areas in central Alberta are producing whole milk for manufacturing purposes. This milk is picked up daily for delivery to milk concentrating plants and cheese factories. Prices for this milk are approximately 60% of that paid by fluid markets.

LEGISLATION AFFECTING DAIRY PRODUCERS

The production, processing and sale of milk and its products is governed by legislation at the federal, provincial and municipal level. Departments of Agriculture and Public Health administer regulations at all levels. In addition, most provinces have Milk Control Boards to establish prices for fluid products. The provincial legislation in Alberta which affects dairy producers is found under three separate acts summarized in the following paragraphs:

1. THE DAIRYMEN'S ACT AND REGULATIONS

Administered by the Dairy Branch, Department of Agriculture. Provision is made for the licensing of all dairy manufacturing and processing plants. Licensed plants must supply a bond to protect producers against financial loss. Provision is made to license qualified graders and testers of milk and cream and those engaged in this work must be licensed. Regulations under the act set forth grade standards for cream and manufacturing milk. The basis for payments to producers must be outlined by the licensed plant which must furnish to the producers a statement covering all purchases of milk and cream. Provision is made for minimum standards covering such items as construction, operation, sanitation, equipment, etc.

The legislation prohibits the sale of milk which contains preservatives, adulterants or that which has been skimmed or diluted. Producers of fluid milk must provide a milk house with the necessary sanitary facilities. Regulations require that farm bulk tanks conform to 3-A Standards and be installed in a milk house with proper facilities for washing and sanitizing.

2. REGULATIONS OF THE PROVINCIAL BOARD OF HEALTH (made under authority of The Public Health Act)

These regulations require that all producers of milk for human consumption obtain a certificate of registration from the local Board of Health. Provision is also made to check the health of the employees on the producers' premises. Cows must be free from tuberculosis. Certain facilities for assuring high quality milk must be provided.

3. THE PUBLIC UTILITIES ACT

This act empowers the Board of Public Utility Commissioners to inquire into any matter relating to the production, supply, distribution and sale of milk. The Board can prescribe areas which shall be regulated by orders. Approved schedules of minimum prices are established by the Board having regard for the interests of the public and continuity of supply. Controlled areas presently include: Bowden, Calgary, Camrose, Crows Nest Pass, Edmonton, Lethbridge, Medicine Hat, Ponoka and Red Deer.

RULES FOR BETTER MILKING

1. Prepare the Cow.
   —Avoid excitement.
   —Wipe and massage udders and teats with a clean cloth wrung out of a very warm disinfectant solution.
   —Use separate cloths for each cow and wipe udder dry after washing.
   —Milk the first two or three streams into a strip cup.
   —Where flakes or abnormal milk is detected, place cow at end of milking line.
2. Milk Fast.
   —Put on teat cups a half minute after washing the udder.
   —Strip by machine — when milk flow slows down pull down on the teat cups with one hand and massage the udder with the other hand. (It is important that the teat cups be removed immediately milk stops flowing.)
   —Dip teat cups in clean water and then a disinfecting solution between each cow.
3. Operate the Milking Machine according to Manufacturer's Directions.
   —Check pulsation rate and level of vacuum regularly.
   —Clean vacuum lines at least every other month and whenever milk is known to have entered the line.
4. Handmilking Requires
   —Clean clothes.
   —Clean dry hands.
   —Quick milking.

PRODUCTION OF QUALITY MILK AND CREAM ON THE FARM

I Basic Requirements:
   —A clean healthy herd housed in a clean well ventilated building with clean adjoining areas.
   —Strict cleanliness of personnel at milking time.
   —An adequate potable water supply for the stock, for cooling purposes and for all cleaning operations.

II Essential Equipment Includes:
—a milk house of suitable design and size; stainless steel or satisfactorily tinned utensils;
—a single service filter strainer; detergents and cleansers suitable to the water supply;
—chemical sterilizers (e.g. chlorine solution) for "rinse before use" purposes; (lye solution, see Special Milking Machine Treatment.)
—stiff dairy brushes — do not use cloths or steel wool.
—a non-corrodable rack for draining and storing all utensils.

III General Procedure for Cleaning and Sanitizing Utensils:

1. **Rinse** with cold or lukewarm water immediately after use so as to remove milk residue from utensils. This will prevent milk stone formation.
2. **Wash,** scrub utensils with a stiff dairy brush using hot water and a detergent. This will remove most of the milk residue from the surfaces.
3. **Rinse** with clean very hot water. This removes all traces of detergent, heats the metal, and assists in drying.
4. **Drain** all utensils by placing on a drain rack.
5. **Sanitize** just before use by rinsing with a chemical solution such as chlorine. This sanitizes surfaces in which milk or cream comes in contact.

Special Treatment for Milking Machine Clusters

Milking machine clusters are the most difficult of the farm dairy equipment to keep clean, and additional treatment is recommended.

6. **Wet Storage**

With a short tube milker the milking tubes and inflations are stored in a freshly prepared ½% lye solution in a crock between milkings.

With a long tube milker the clusters are placed on a rack and filled with the ½% lye solution.

7. **Defatting**

Two sets of liners are required: one set is rested and defatted for two weeks in a 5% lye solution while the other set is in use and cleaned as above.

8. **Immersion Cleaning**

(see free advisory leaflet No. 159 for complete details.)

This is an alternative procedure to steps 1 to 7 above. The assembled clusters and lids without the pulsators of both long and short tube milkers are merely rinsed and kept between milkings in mixed lye EDTA solution. Buckets and other metal equipment are washed and sanitized (steps 1 to 5).

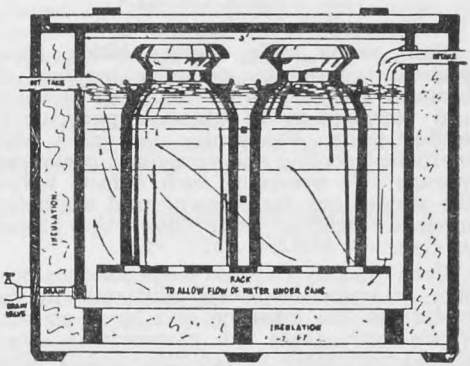
IV Cooling:

Immediate, fast cooling of milk and cream to at least 50°F. and preferably 40°F. is essential. Use a good thermometer. Low temperatures should be maintained during storage period up to shipping time. Prevent freezing. During shipping, protect milk or cream from extremes of temperature.

Effective means of cooling are:
(a) circulating cold water in a tank of sufficient capacity; and
(b) mechanical refrigeration.

Air cooling is not satisfactory for fast cooling. Experiments have shown that water cools 21 times faster than air at the same temperature.

Precaution—Do not mix fresh warm milk or cream with the previously chilled supply. Always cool first — then mix if necessary (unless using bulk tank).



"Water Cooling Tank" located between pump and stock watering trough.

Bulk Cooling Tanks

Bulk tanks are of two types:
(a) Those which are filled by gravity and are at atmospheric pressure and
(b) vacuum tanks in which the vacuum is maintained by the vacuum pump of the milking machine.
This is usually combined with a pipeline milker.

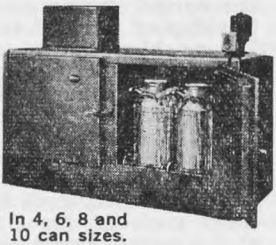
Two systems of refrigeration are used:
1. Ice bank and
2. Direct expansion of the refrigerant.

The Ice Bank system requires the compressor to work 80 - 90% of the time. With the direct expansion type, the compressor is larger and works for only 25 - 30% of the time. The direct expansion unit costs more than the ice bank type but direct expansion is less costly to operate because the ice bank type also has a circulating pump.

Milk comes into the tanks at between 92 - 98° F. Most tanks cool the first milking down to approximately 36° F. in 1½ - 2 hours. Subsequent milkings are cooled more rapidly because there is a greater surface area of the cooler to operate and because the existing cool milk acts as a reserve of cold. The maximum temperature of the blend will be about 45 - 50° F.

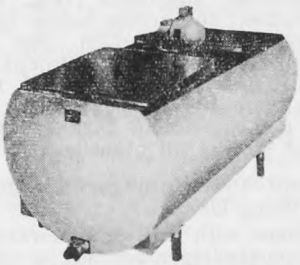
With highly flavoured feeds, there may be some advantage in the vacuum tank which may remove some feed odours from the milk at milking time.

CAN COOLERS



In 4, 6, 8 and 10 can sizes.

Open - front design saves heavy can lifting. Ice-water spray cools milk fast.



"Farm Bulk Tank"

MILK AND CREAM DEFECTS OF FARM ORIGIN

1. Flavor Defects

Sour, malty, stale, cheesey, bitter. Most probably caused by excessive numbers of bacteria resulting from improper cleaning and sterilization of utensils, particularly rubber parts. Frequently associated with inefficient cooling and sometimes prolonged storage. To overcome such defects follow the suggestions for cleaning and sanitizing utensils together with those on proper cooling.

Feed. Highly flavored feeds whether pasture or stored feed, can taint milk in the udder via the intestine and blood stream. When such feeds are unavoidable, they should preferably be fed immediately **after** milking or prior to 3 - 4 hours before milking.

Weeds. Many weeds, notably stinkweed, garlic, mustard, etc., can taint milk. Keep cows off pastures containing such weeds for 3 - 4 hours before milking.

Odors. Barny flavors are usually caused by inhaled odors resulting from poor ventilation. Such odors pass from lungs to blood stream and hence to the milk. Exposing milk to any strong odor (barn, paraffin, silage, etc.) for a short time can cause the odor to be absorbed by the milk.

Oxidized. Cappy, cardboard or metallic taints are all a result of fat oxidation, caused by exposure to copper or sunlight. This condition is more common when animals are stall fed. Good quality feed will assist in counteracting the defect.

Rancid. Sometimes called bitter flavor or "winter" flavor on cream. Caused by **fat** splitting enzymes. Avoid agitation of **milk** when warm (particularly with pipe**line** milkers). Troublesome during winter but minimized by good quality roughage. Individual cows late in lactation may also be responsible for rancidity.

Acetone. Caused by ketosis, a physiological upset of an individual animal. This milk should be excluded from the bulk.

2. Physical Defects

Ropy Milk. Usually caused by slime producing bacteria from unsterile utensils. Bacteria may originate from stagnant ponds in which animals wade. Mastitis milk sometimes exhibits **ropiness.**

Flakes and Curds. Caused by advanced mastitis or freezing. The use of a stripcup will help to eliminate mastitis as a cause. Freezing must also be avoided because of its effect on the physical appearance of milk and cream, but equally important are the difficulties of accurate sampling and processing caused by the resulting destabilized and oiled-off fat.

Difficult churning. Seasonal changes in the hardness of butterfat and reduction in the size of butterfat globules, can increase churning time in fall and winter. Raising the churning temperature usually corrects the difficulty.

3. Other Defects

Extraneous matter. Milk and cream must be protected at all times from dust, insects, rodents. Poor sediment tests can result from careless storage and from inefficient udder washing.

Insecticides. Fly sprays can be toxic in milk. Feeds from pastures, hay or grain, treated with insecticides can result in these substances being passed on to milk. Great care should be exercised when buying feed as the Federal Food and Drugs Regulations prohibit the sale of milk containing residues from insecticides.

Preservatives. Any preservative such as formaldehyde is prohibited by law in dairy products and should never be used on milking equipment.

Sanitizers. The accidental or deliberate addition of sanitizers or detergent-sanitizers may impart a chemical taint to the milk in which case the whole shipment may be rejected.

Antibiotics. Traces of antibiotic in milk following treatment for mastitis can be a public health hazard and interfere with the manufacture of cheese. Milk from any animals so treated should not be sold for a period of time sufficient to assure the milk being free from adulteration. Usually 72 hours after the last treatment is sufficient time, however, if the antibiotic is in an ointment base a period longer than 72 hours may be required and advice on this should be sought.

Water. Dairies are now routinely testing for abnormal water content of milk. Inadequate draining of bulk milk tanks or pipelines after rinsing should be avoided as this may not be distinguished from deliberate adulteration.

Adulterants in milk are covered by the Dairymen's Act and Regulations and in cases of doubt advice should be sought or reference made to the complete Act.

FACTORS CAUSING VARIATIONS IN BUTTERFAT TEST

Milk:

(a) Heredity — breed and individuality of the cow.
(b) Physiology — age, condition and stage of lactation.
(c) Environment — season of the year and time of freshening.
(d) Management — completeness of and interval between milkings. Exercise and feed.
(e) Miscellaneous factors — health of cows and farm use of milk and cream.

Cream:

(a) Butterfat test of the milk.
(b) Position of cream or skimmilk screw.
(c) Temperature of the milk.
(d) Use of slime clogged separator bowl.
(e) Rate of inflow to bowl.
(f) Speed of separator — voltage changes affect speed of power separators.
(g) Amount of flushing of separator bowl.

FARM PROCESSING OF MILK AND CREAM

MANUFACTURED PRODUCTS:

A commercial market for farm made dairy products is practically non-existent. Interest in these products will consequently be limited largely to the requirements of the household. Instructive bulletins available are as follows:

(a) Buttermaking on the Farm — Farm Bulletin No. 52, Canada Department of Agriculture.
(b) Farm Cheesemaking — Joint Series Publication No. 5, available through District Agriculturists.

HOME PASTEURIZATION OF MILK:

Rural families can provide themselves with a safe milk supply. Healthy appearing cows are insufficient assurance that the milk will be free from contagious infection. The best protection is provided by heat treatment of all milk. The familiar double boiler, always available in the farm home, is suitable for this purpose. The milk in the vessel must be protected with a cover and stirred occasionally to insure uniform heating until a temperature of 160° F. is recorded by an immersed reliable thermometer. Rapid cooling of the milk should follow immediately. This can be accomplished by immersing the inner vessel of the boiler in a container of cold water.

Several types of electrically operated home pasteurizers are now available and may be purchased from dairy equipment distributors and mail order houses. For further information refer to Bulletin No. 43, University of Alberta.

USE OF DAIRY BY-PRODUCTS ON THE FARM

Cream shippers have a valuable food product in skimmilk. Well cooled skimmilk produced under strict sanitary conditions is an excellent food for regular table use especially if pasteurized. (See section on "Home Pasteurization of Milk".) As a feed for calves, hogs and poultry, it is one of the best farm produced feeds when used as a supplement to grains. To evaluate skimmilk as a feed, keep in mind that on the basis of protein alone "1,200 pounds of skimmilk is equal to 100 pounds of high protein supplement (35%)". In addition, skimmilk contains vitamins and minerals both of which are valuable to the growth and well being of young animals.

Buttermilk and whey, which are available to those farmers residing in the vicinity of creameries and cheese factories, provide a cheap source of excellent feed for pigs and poultry. Buttermilk is equal to, while whey is considered to be half the value of skimmilk. To feed these by-products successfully it is important that they be fed fresh with little or no increase in acidity, or allowed to sour. Wide variations in the method of handling buttermilk and whey are reported to result in serious digestive difficulties.

ALBERTA'S FROZEN FOOD LOCKER PLANT INDUSTRY—1961

Number of plants operating	131
Number of lockers installed	34,125
Number of lockers rented	23,881
Total pounds processed	17,259,004
Inspections during the year	1,030

LEGISLATION AFFECTING LOCKER PATRONS

The Alberta Frozen Food Locker Act and Regulations:

Provides for the licensing and inspection of all plants that process and store frozen foods.

Requires that satisfactory temperatures be maintained for the chilling, ageing, sharp freezing and storage of food products.

Makes provision for sanitary plants and equipment in the processing of foods for freezing and storing.

Requires satisfactory packaging materials and methods of wrapping of all food products for storage.

Requires that all products be properly identified.

Offers protection to patrons through compulsory and adequate insurance on food products.

REFERENCES :

Dept. of Agriculture, Edmonton.

Annual Report, 1961.

Pub. 99—Two Minutes to Wash Cream Separator.

Pub. 93—Care of Milk Machines.

Pub. 87—How About Your Milk Test?

Pub. 6—Your Cream Test Goes Up and Down—Why?

Pub. 6—Farm Cheesemaking.

Pub. 313—Preserve by Freezing.

Pub. 844—High-Quality Milk.

Queen's Printer, Edmonton.

Dairymen's Act and Regulations.

Frozen Food Locker Act and Regulations.

Public Utilities Act.

Provincial Board of Health.

Regulations respecting dairy farms, milk plants, etc.

University of Alberta, Edmonton.

Bul. 43—Milk and Cream Defects of Farm Origin.

Joint Series Pub. 159—Immersion Cleaning of Milking Machines.

Poultry

Poultry production in Alberta is becoming more specialized with increasing numbers of farmers depending upon poultry for their main source of farm income. They are engaged in commercial egg production, broiler production, turkey growing, turkey broiler production, or turkey hatching egg production.

COMMERCIAL EGG PRODUCTION

LAND REQUIREMENT

Where replacement stock is brooded and reared indoors the amount of land required is no more than that necessary for the buildings provided, and perhaps some allowance for future expansion. If, however, the rearing program involves the use of range, enough land should be available for range rotation, necessary for the prevention of parasites and diseases. The lighter the soil and the better the drainage the less land required. About 20 acres, divided into three ranges of equal size, should prove adequate for raising two thousand pullets.

BUILDINGS

General type and location — In general, three types of buildings are required; brooder houses, range shelters and laying houses. See references.

SIZE OF FLOCK

Poultry cost surveys have indicated that just about as much labor is required for two hundred birds as for four hundred. In addition, smaller flocks tend to be neglected, particaularly during seeding and harvest.

An individual intending to earn his total income from a laying flock should keep at least two thousand birds and preferably five or more thousand.

STOCK

Breed — The important breeds might be divided roughly into egg-laying, general-purpose, and meat type breeds.

The Mediterranean breeds are generally referred to as egg-laying. Of these, only the Single Comb White Leghorn has attained very wide acceptance in the commercial field. More pureline White Leghorns and strain-cross White Leghorns are sold in Canada than any other breed. This is because the Leghorn excels most other breeds in egg production, efficiency of feed conversion, fertility and hatchability. The Leghorn lays white shelled eggs.

The general-purpose breeds are those that, in addition to being fairly good egg producers,are also good producers of meat. They are popular on general farms. Of the general-purpose breeds the most important are the Light Sussex, New Hampshire, and Barred and White Plymouth Rocks. These lay brown shelled eggs.

The meat type breeds are discussed under broiler production.

Quality — The best of feeding and management will not make birds produce that do not have the inherent ability to do so. Therefore, it is of prime importance that the poultryman should seek stock that possesses the inherent ability to live and to produce eggs of high quality through the laying year.

Number of chicks to buy — For replacement purposes this will depend on the percentage of the laying flock to be replaced, expected mortality during the growing period and the quality of stock obtained. It is customary to purchase 2½ to 3 times as many mixed chicks or 1¼ to 1½ times as many sexed chicks as the number of pullets one wishes to house in the fall.

When to buy chicks — To take advantage of high fall egg prices, replacement chicks should be purchased in February or March.

BROODING AND REARING

BROODING FACILITIES

Two types of housing are commonly used:
(1) the colony or portable brooder house
(2) the permanent brooder house.

The colony system involves the use of small portable houses located about 200 feet apart on range and these are moved at three or four week intervals during the rearing period.

Brooder houses vary in size and shape, but in general are 10' x 12', 10' x 14', or 12' x 12' in dimensions. (See references.) Houses larger than this should be avoided because they are difficult to move.

Colony brooder houses are usually heated with coal, oil or propane gas; however, when drawn in close to the other buildings they often are heated with either natural gas or electricity.

A 10' x 14' brooder house is suitable for starting 250 to 300 chicks. More than 300 chicks in a house of this size will cause overcrowding and result in poor rate of growth, lack of uniformity, smothering, cannibalism or disease.

The colony system, when properly managed, is very satisfactory. Green range and sunlight tend to lessen nutritional deficiencies and reduce disease hazard. Rotating the range for use only one year in three and frequent moving of the houses during the brooding and rearing period results in a decrease in exposure to infection. The result is that range reared birds are usually hardy, vigorous, and have a good reserve of nutrients when they are moved into the laying house.

The permanent brooder house resembles a laying house in construction and sometimes is provided with a sunporch. The pen size may be large or it may be comparable to colony brooder house units. The use of the permanent brooder house system has become more common where brooding is not confined to a single season of the year.

Heat may be supplied by separate brooders in each pen; or by a central heating system of hot water, steam or heated air to provide a temperature of 70° to 75° F. In the latter case brooding heat is supplied by continuous hot water hovers, gas or electric hovers or infra red lamps. In still others the use of radiant heating is employed.

RANGE HOUSES AND EQUIPMENT

Range houses are usually of "A"-type or open front construction, (see references) and are used for chickens that no longer require artificial heat. Range houses should be equipped with roosts with wire underneath, or slatted floors. Self-feeders and waterers also should be provided.

FEEDING AND MANAGEMENT

Cleaning — The brooder house should be thoroughly cleaned before the chicks arrive. Start with the removal of litter and droppings. Wash down the ceiling and walls to ensure that all dirt and dust is removed. The floor should be soaked and adhering litter and droppings removed by scraping and sweeping. Next, the floor should be treated with lye solution (1 can of lye to 5 gallons of water) allowed to soak overnight and finally scrubbed and washed with water. After the house has dried it should be thoroughly disinfected with a reliable disinfectant. The house should not be disinfected until it is thoroughly cleaned because disinfectants are relatively ineffective on dirty surfaces. All equipment also should be thoroughly cleaned and disinfected. Following cleaning and disinfecting, the house should be given a coat of whitewash. (See references.)

Brooder operation — The brooder stove should be put into operation at least three days before the chicks arrive. See that a proper chimney jack is used and that the floor is protected against fire by a sheet of hard asbestos or other fireproof arrangement. Check to see that the stove is operating properly and that the temperature can be regulated. The brooder should be capable of maintaining a temperature of 95° to 100° F. at the edge of the hover two inches above the litter.

As the chicks age they require less heat. The initial brooding temperature of 95° F. should be reduced about 5° F. per week until it is down to 60° to 65° F. when the chicks are 5 to 6 weeks of age. The behavior of the chicks is the best guide to temperature. If they are cold they will chirp and huddle under the hover while if they are too warm they will move away.

A room temperature of 70° to 75° F. is

quite satisfactory for small chicks, and this may be reduced to 60° to 65° F. by the time the birds are 6 weeks old.

Litter most commonly used in the Prairie Provinces are wheat straw, shavings, peat moss or a combination of these.

During the first week of brooding, the litter under the hover should be removed daily. Later, weekly cleaning will suffice, and when the birds are outside most of the day, cleaning every two weeks will be adequate. Daily stirring of litter is recommended and water spillage should be kept at a minimum.

Floor space requirements—Approximately ½ square foot of floor space per bird should be provided to 4 weeks of age and one square foot from 4 to 8 weeks of age. With chickens in confinement, the floor space should be increased to 2 square feet per bird at 12 weeks of age and to 3 square feet at 16 weeks of age.

Ventilation—During the first few days of brooding, little ventilation, other than that provided by opening and closing the door, is needed. As the chicks age, more ventilation should be provided by opening the windows or by mechanical ventilation. On sunny days, see that sufficient ventilation is provided to avoid overheating.

Feeders and Waterers — From day-old to 4 weeks of age, chick size feeders should be used, at 1 foot of feeding space for each 10 to 12 chicks. At 3 to 4 weeks of age, intermediate size feeders should be introduced and the feeding space doubled.

At the start, 4 one-gallon fountains will supply the water required by 250 to 300 chicks. Initially, they should be placed on the floor, but as soon as the chicks learn to use them, they should be placed on low wire stands to prevent the chicks from coming in contact with the damp litter which is usually found around fountains. At 4 weeks of age larger fountains or automatic founts should be introduced. Water supply is extremely important. In the past few years it has been noted that heavy mortality has occurred on farms where the drinking water is very hard. The water supply should be tested for hardness before being used for poultry.

Feeding — Use chick starter until chicks are 6 weeks of age. Provide chick size insoluble grit as an aid to utilization of the feed and development of the gizzard.

From 6 weeks to sexual maturity the birds should have access to mash (or concentrate) and grain and oyster shell on a free choice basis. The chick size grit should be replaced by intermediate size grit.

Feed Consumption — Two pounds of starter for each chick purchased should take care of the feed needed to 6 weeks of age, at which time the chicks are usually placed on growing feeds. Twenty to twenty-five pounds of feed is required to raise a pullet from 6 to 20 weeks of age.

Early Roosting — Forcing roosts should be lowered when the chicks are 3 to 4 weeks old and the chicks should be driven up on the roost each night until they go up of their own accord. Losses from smothering are less apt to occur if the chicks are roosting properly.

Getting the chicks out of doors—Weather permitting, get the chicks out of doors on clean land by the time they are 4 to 6 weeks of age.

Separate the cockerels and pullets at 4 to 8 weeks of age.

Range crops — Annual crops such as oats or rape or perennial grasses and legumes such as alfalfa or clover provide good range for poultry.

Moving the brooder and range houses — The brooder houses or range shelters should be move dat least once a month in order not to over-contaminate the range in one area and to avoid killing the grass under the houses.

THE LAYING FLOCK

HOUSING

The laying house should be designed to provide maximum comfort for the birds throughout the laying year. (See references.)

Floor space — Heavy breeds should be allowed 3 to 4 square feet of floor space per bird, and light breeds 2½ to 3½ square feet. Forced ventilation, and ample feeding and watering space, may reduce the floor space required to 2 square feet per bird.

EQUIPMENT

Labor required for feeding and watering the birds, gathering the eggs and cleaning the house can be minimized by:

(1) Installing automatic waterers, either pressure or gravity.
(2) Using automatic feeders. If this is not feasible, use hanging or other types of feeders so that feeding may be done quickly and conveniently.
(3) Arranging the nest close to the door so as to reduce the time required to gather eggs.
(4) Screening off dripping boards or using dropping pits.
(5) Using the deep-litter system of litter management.
(6) Making provision for feed storage in the buildings.

Nests — Some operators prefer individual nests while others prefer community type nests. Individual nests are usually about 12" to 14" wide, 14' high and 14" deep. One such nest should be provided for each 5 to 6 layers. Community nests 2' x 4' or 2' x 6' are common. A community nest 2' x 4' should be provided for each 50 layers.

Feeders — High producing flocks should have at least 33 linear feet of feeding space per hundred birds. Feed troughs for laying birds should be about 18" off the floor and should have reels to keep the birds out of the feed. The troughs are usually about 6" deep and 8" wide, have flat or V-shaped bottoms and a lip to reduce feed wastage.

A recent trend in larger flocks has been towards the use of automatic feeders, but these are not economical in flocks of less than 1,000 birds.

Feed storage — A bin should be provided in the building.

Waterers — The use of automatic waterers in the laying house is desirable and will greatly reduce the labor required. If these are not employed, use sufficient water fountains or troughs to supply 3 to 5 gallons of water per hundred birds per day. Waterers should be placed on stands or over the dropping pits if the latter are present.

Perches — Should be built in sections that may be easily raised to facilitate cleaning of the dropping boards or pits. They may be made of 2' x 2" material, rounded on the edge and set 13" to 15" apart. Six to eight inches of roosting space should be allowed for Leghorns and 10" to 12" for heavies. The perches should not be more than 3' above the floor.

Either dropping boards or dropping pits may be used in conjunction with the perches. Dropping boards are generally built in sections and are located about 30" above the floor. Dropping pits are usually about 18" deep.

Whether dropping boards or dropping pits are used, they should be screened off to keep the birds away from the droppings. Fourteen gauge 1" x 2" mesh welded wire or 2" hexagonal fox wire is very satisfactory for the purpose. In place of perches and wire over the pits, 2" x 2" wooden slats spaced 1¼" may be used.

MANAGEMENT OF THE LAYING FLOCK

Cleaning — Before the pullets are moved into the laying house, the equipment and the house should be cleaned, scraped, washed with water and scrubbed with a lye solution (1 can of lye to 5 gallons of water) and allowed to soak overnight. It should then be washed again with water, disinfected by spraying with a good disinfectant and whitewashed.

Litter — Wheat straw is satisfactory, and is usually available at a low price. Shavings or peat moss or a combination of same may be used, but are usually more expensive than straw. Shavings do not absorb very much moisture, and require to be changed often. Peat moss has a much greater moisture holding capacity than either straw or shavings but tends to become very dusty.

There are two common methods of managing the litter. The conventional method has been to keep the floor of the laying house well covered with clean dry litter which is changed every two weeks during the winter and once a month during the summer.

A newer method of litter management, and one that has received wide acceptance in commercial flocks, is the use of "deep-litter" or "built-up" litter. Four to six inches of litter is placed in the laying house prior to housing the pullets. It is usually done in August or early September so that fermentation will commence before the weather becomes too cold. Clean litter is added at intervals until the litter is eight to ten inches deep. The litter should be stirred regularly. Under this system the litter, if properly handled, needs to be changed only once a year. If the litter becomes wet, the addition of hydrated lime is recommended at the rate of about 10 pounds per 100 square feet of floor area. The hydrated lime should be stirred into the litter.

Time of housing — The pullets should be housed as they are coming into lay. Continue the same feeding practice that was used on range for a few days until the birds become accustomed to the new quarters.

Artificial illumination — is used on the laying flock to stimulate egg production. One 40-watt bulb, equipped with a reflector, six feet above the litter may be used for each 200 square feet of floor space. In houses up to 24 feet wide a single row of lights is satisfactory, but in houses wider than this a double row of lights should be used.

The use of sufficient artificial light to give the birds a thirteen to fourteen hour light day is usually started in the fall when the pullets reach their peak of production and is continued through until spring when the lengthening of the hours of daylight eliminates the need. In addition to using artificial light to stimulate winter production, lights should also be employed at the end of the laying year to prolong production, and following the annual moult to bring layers back into production.

FEEDING OF THE LAYING FLOCK

The all-mash system—In this system the entire ration is fed in ground form. No whole grain is fed. With this method there is less likelihood of hired or unskilled labor making a mistake.

The chief disadvantages of the all-mash system of feeding are:

(1) All of the ingredients have to be ground.

(2) There is sometimes a tendency for pullets to lose weight in the fall when they come into peak production. If the loss in weight is not checked, some of the birds are likely to go into a pause. This may be avoided by increasing the proportion of high energy feeds such as wheat and by decreasing the proportion of oats, barley and mill by-products in the laying ration.

(3) The litter and dropping boards tend to be wetter when an all-mash ration is fed than when a mash-grain or concentrate-grain system is used.

The mash-grain system — involves feeding a laying mash (containing about 18% protein) with scratch grain. Laying mash may be purchased ready-mixed or may be made by mixing 100 lbs. of 35% protein laying mash concentrate with 300 lbs. of ground grain (150 lbs. ground wheat, 75 lbs. ground oats and 75 lbs. ground barley).

A suggested schedule of feeding is as follows:

(1) Keep laying mash in front of the birds at all times.

(2) Feed 12 lbs. of scratch grain (two parts wheat, one part oats by weight) per 100 Leghorns or 13 lbs. per 100 heavies per day. One-third of this may be fed in the morning and two-thirds in the evening about an hour before the birds go to roost.

The concentrate-grain system — In this system laying concentrate (usually pelleted) is fed along with scratch grain. The system permits maximum use of home-grown grains which not only do not have to be ground but may be self-fed in hoppers.

The main disadvantage of the system are:

(1) Feed efficiency is reduced slightly.

(2) Individual birds may consume different proportions of grain and concentrate resulting in variability in yolk color.

(3) If concentrate and grain are fed in separate hoppers on a free choice basis the birds tend to consume a higher level of protein than is necessary to maintain a high rate of egg production. Since protein is an expensive part of the ration this increases the cost of egg production.

Regardless of the feeding system employed oyster shell, insoluble grit and clean water should be available to the birds at all times.

Feed consumption — The amount of feed required for a laying hen is dependent on a number of factors such as the weight of the bird, the rate of egg production and the energy content of the feed. In general, the larger the bird the more feed is required for maintenance. As the rate of production increases, extra feed above that required for maintenance, is needed for egg formation. In addition, the feed required per bird per day is more or less directly related to the productive energy content of the ration. Thus, on high energy rations (rations high in wheat and low in oat and barley content) proportionately less feed is eaten than on lower energy rations (rations low in wheat and high in oat and barley content). This factor may be of considerable practical importance to the producer. A high energy feed, though more expensive per pound, may result in lower production costs than can be obtained on a low energy feed. Value of a feed should not be based on the cost per ton, but rather on the cost of feed required to produce a unit of product, such as a dozen eggs or a pound of poultry meat.

CULLING THE LAYING FLOCK

Culling the flock is a most important activity. It removes sick birds and poor producers and so increases the average quality of the birds that are kept. It reduces the amount of feed required to produce a dozen eggs and thus improves the efficiency of production.

Two types of culling may be used — **Continuous culling** refers to the removal throughout the laying year of obviously sick birds and those definitely out of production. In **systematic culling** the birds are crated, handled and the culls are removed. This entails a good deal of labor. As a result, this type of culling is usually only done a few times during the laying year. If a good strain of chickens is obtained, and only good quality birds are put into the laying house, systematic culling should not be necessary until the birds have been laying for eight months. Monthly culling may then be necessary until the end of the laying year.

MAINTAINING EGG QUALITY

To ensure high returns from egg production it is essential that eggs of high quality be produced and that the quality be maintained until the eggs reach the consumer. Feeding and management factors influencing egg quality:

(1) If possible, obtain a breed or strain of birds that is known to lay eggs with a low incidence of blood and meat spots. Generally speaking, Leghorns produce fewer blood and meat spot eggs than certain of the heavy breeds.

(2) Feed a balanced laying ration and supply oyster shell free choice to ensure good shell quality.

(3) Keep the laying flock confined. Birds that are allowed to range at large tend to consume too much green feed and as a result lay eggs with dark yolks.

(4) Do not have males in the pens except during the breeding season. The germinal discs (referred to as germ spots) of fertile eggs undergo development on exposure to high temperatures.

(5) Produce clean eggs by keeping nests and pens clean. Gather the eggs at least four times daily.

EGG QUALITY CONTROL

Eggs lose their quality if not properly cared for. Factors that contribute to the loss in quality:

(1) At **high temperatures,** interior quality is lost rapidly. Eggs should be gathered in wire baskets and cooled as quickly as possible after they are laid. Following cooling the eggs should be packed in clean trays, large end up, and held at 50° to 55° F. until they are taken to market.

(2) At higher relative humidities the rate of loss of moisture from eggs is less than when the relative humidity is low. A relative humidity of 60 to 70 percent in egg rooms is recommended.

(3) As eggs age there is loss of quality regardless of the storage conditions. For this reason eggs should be marketed twice weekly.

(4) Eggs readily take on **odors**; egg rooms should be free of vegetable, coal oil, musty or other odors.

(5) **Rough handling** may result in cracked or broken shells, loose air cells, or a decrease in interior quality, all of which cause lower grade returns.

CHICKEN HATCHING EGG PRODUCTION

In general, the feeding and management of hatching egg flocks is similar to that outlined for commercial egg flocks. Certain aspects, however, should be given additional attention.

Costs involved in hatching egg production — It costs more to produce hatching eggs than commercial eggs. The principal items of extra cost are as follows:

(1) Cost of banding and blood testing breeders.

(2) Extra cost of breeding mash as compared to laying mash.

(3) Cost of males. To the purchase price of the males less their salvage value at the end of the season, one should add the value of the eggs that a like number of pullets would have produced.

(4) Risk. Risk involved in the hatching egg business includes disease, the production rate during the hatching season, percentage hatch, and the length of hatching season.

(5) Another item is the strain or breed of bird kept. It is possible that the strain kept for hatching-egg production may not be the same as one would keep for the production of commercial eggs. The hatching egg market may demand breeds or strains that do not possess the egg laying ability, feed efficiency or livability of strains that might be kept for market egg production.

FEEDING AND MANAGEMENT OF THE HATCHING EGG FLOCK

Feeding — The hatching egg flock should be fed a breeding ration rather than a laying ration. Feeding of the breeding ration should commence about 6 weeks prior to breeding and continue throughout the breeding season. Any of the systems of feeding for laying birds may be followed; however, the best control of nutrient intake is obtained by the all-mash method.

Fertility — In order to obtain a high percentage hatch, good fertility is necessary. Strong vigorous cockerels should be used, and care should be exercised that they do not get their combs frozen; this will result in low fertility. In flock matings, one male for 12 to 15 females in the case of heavy breeds, and one male for 15 to 18 females in light breeds, is adequate.

The males should be placed in the pens about ten days before collecting eggs for hatching. They may be removed a week before the end of the hatching season without loss of fertility.

Care of hatching eggs — Hatching eggs should be handled in much the same manner as market eggs. The main points to be observed are:

(1) Collect eggs four times daily and cool quickly to 50° to 55° F.

(2) Do not wash hatching eggs unless by a proper egg washing machine. Follow manufacturer's direction. Dirty eggs may also be cleaned with sandpaper or fine steel wool.

(3) Only sound shelled eggs of suitable size, shape, and shell quality should be shipped to hatcheries. The eggs should be packed large end up in clean Keyes trays.

(4) Hold hatching eggs at 50° to 55° F. Avoid chilling or overheating since these result in lowered hatchability.

(5) Shipment to the hatchery should be made twice weekly and eggs should be protected against extremes of temperatures during shipment.

(6) Rough handling of hatching eggs results in lowered hatchability.

BROILER PRODUCTION

Size of enterprise — It is generally considered that marketing of 50,000 or more broilers a year is necessary to ensure a satisfactory income from broiler raising.

Type of operation—Broilers are marketed at 8 to 10 weeks of age at an average weight of 3 to 3½ pounds. Usually they are raised in groups of 5,000 to 10,000 with four or five marketings a year. This permits a thorough cleaning of the premises between each batch of broilers and prevents disease better than the continuous type of operation where a new lot of broiler chicks is started each week. The latter system, however, yields a more regular supply, which may be desirable under certain circumstances.

Broiler chicks — A white broiler is preferred. The majority of broiler chicks sold today come from crosses involving dominant white Cornish-type males mated to meat type females. The latter consist largely of special meat strains of White Rocks and New Hampshires. Chicks of this type,

under proper feeding and management, are capable of averaging three pounds in weight at nine weeks of age with a feed requirement of 2.5 pounds of feed per pound of gain.

Housing and equipment — Broiler houses are generally of the permanent brooder house type, one square foot of floor space being provided for each broiler. Houses should be force ventilated, equipped with mechanical and/or hanging feeders, automatic waterers and, of course, with brooders. Some auxiliary heat also is necessary to facilitate the maintenance of proper temperatures, 65° to 70° F., in the house.

Brooding — See details under brooding for commercial egg production.

Feeding — Broiler chicks should be fed a high energy broiler ration containing approximately 22% protein until they are 6 or 7 weeks of age and a high energy finishing ration containing approximately 19% protein until they are ready for market.

TURKEY GROWING

Size of enterprise — It is generally considered that 5,000 or more turkeys must be raised to ensure an adequate income from turkey growing.

Type of operation — Turkeys are usually raised on open range, however, recently some growers have adopted confinement rearing in sheds. Under the rotational range system one acre should be provided for each 100 to 200 turkeys raised; in the confinement method 4 to 6 square feet of floor space is provided for each turkey.

Type of poult — The Broad Breasted Bronze turkey is preferred by most growers, however, recently growers have shown interest in Broad Breasted Whites. Where a specialized market exists for a small type turkey the Beltsville White may be found more suitable.

Housing and equipment — The brooding accommodation and equipment required is similar to that required for large scale chicken brooding. Range shelters may be of cheaper construction than for chickens since all that is needed is protection from wind and storms. Range equipment should consist of large self-feeders, automatic waterers and low movable roosts made from two-by-fours, flatwise, spaced about two feet.

Brooding and rearing — See details under brooding and rearing of chicks for commercial egg production.

Feeding — Poults should be started on a 28 to 30% protein, high energy vitamin fortified starter for ten days. They should then be transferred to a 26% protein starter until they are 8 weeks old at which time they should be fed an 18 to 20% protein growing feed in mash or pellet form plus whole grain. As an alternative, growing concentrate in mash or pellet form plus whole grain may be fed. As soon as the feeding of whole grain is commenced the birds should have access to oyster shell and insoluble grit. Four to six weeks prior to marketing the turkeys should be fed a 13 to 14% protein, high energy fattening mash as the sole feed. It takes approximately 100 pounds of feed to raise a turkey to market age.

Marketing—Females are generally marketed when they are 24 to 26 weeks old and toms when they are 28 to 30 weeks old.

TURKEY BROILER PRODUCTION

For turkey broilers a small white turkey such as the Beltsville White is preferred. The principles involved in brooding, rearing and feeding are similar to those outlined above. About three square feet of floor space per bird is required for confinement rearing. Turkey broilers are generally sold at 12 to 16 weeks of age weighing from 10 to 12 pounds.

TURKEY HATCHING EGG PRODUCTION

For this purpose poults are brooded and reared in much the same manner as outlined under Turkey Growing. Prospective breeders should be selected when 20 to 22 weeks of age. From this time until the birds are placed in the breeding pens the prospective breeders should be maintained on a low energy type ration. Four to six weeks before mating, the toms should be subjected to 12 to 14 hours of light to be sexually active when they are placed with the hens. From this time on both toms and hens receive light. When the pens are mated the birds should be placed on a breeding ration and be fed oyster shell and insoluble grit free choice. Any of the systems of feeding referred to under the feeding of laying birds may be followed; however, the best control of nutrient intake is obtained by following the all-mash method. If fertility is low, artificial insemination is recommended. Broodies should be placed in a broody coop as soon as detected and left there for 3 to 5 days to break them of the habit. While in the broody coop feed the regular ration. Eggs should be collected and handled in much the same way as outlined under Chicken Hatching Egg Production.

REFERENCES :

Dept. of Agriculture, Edmonton.

Plans for Laying Houses.
Poultry Plans Catalog.
Pub. 55—Two Whitewash formulae.
Pub. 133—Broiler Production.
Pub. 1—Turkeys.
Pub. 56—Brooding and Rearing Chicks and Poults.

Dept. of Animal Science, University of Alberta, Edmonton.

Bull. 45—Diseases of Poultry.
Bull. 61—Poultry Production in Alberta.
Farm Plan No. 1—Laying House Plan.
Farm Plan No. 2—Brooder House Plan.
Farm Plan No. 3—Range Shelter Plan.
Farm Plan No. 4—Poultry Equipment Plan.

Livestock Diseases and Pests

VETERINARY SERVICES BRANCH, ALBERTA DEPT. OF AGRICULTURE

This Branch, under the Director of Veterinary Services, offers various services to the Alberta livestock producer. It is primarily concerned with maintaining and promoting the health of all classes of livestock and to reduce the disease loss. The control and eradication of diseases named in the Animal Contagious Diseases Act is the responsibility of the Government of Canada, although provincial authorities do aid in the servicing of federal disease control programs.

Livestock Diseases Act

This Act makes possible legislation and specific disease control programs which are designed to reduce the economic loss from disease. The following programs operate under this Act:

(1) **Brucellosis Restricted Areas** — financial grants to promote compulsory calfhood vaccination and blood testing of cattle at sales. The incidence of brucellosis has been greatly reduced and the movement of infected or carrier cows curtailed. Vaccination is done by practicing veterinarians in co-operation with local Service Boards, or Municipal Affairs in the case of L.I.D.'s. In many districts, the Federal Brucellosis Control Program is also in effect.

(2) **Veterinary Inspection of Auction Markets** — Veterinary inspection is maintained at all major auction markets to prevent the selling of diseased animals which might represent a hazard to the purchaser's livestock.

(3) **Licensing** — The sale of poultry vaccines and livestock medicines, and slaughterhouses (Humane Slaughter) are controlled.

(b) Veterinary Laboratory

This is a large diagnostic service laboratory located at Edmonton providing for the accurate diagnosis of disease. It makes possible the ready recognition of new diseases, and the study of nutritional problems, etc.

(c) Extension Activities

All available media for the dissemination of disease control information is used to keep producers informed of recent developments. These include lectures at the University of Alberta and the Schools of Agriculture. Bulletins on special diseases are prepared for free distribution.

VETERINARY PRACTITIONERS

(1) The Veterinary Services Branch is concerned with the overall disease situation in Alberta. The veterinary practitioner is more intimately concerned with the problems on the individual premises, and the treatment of individual animals.

(2) He is familiar with the problems that exist within specific areas. Without his co-operation neither Federal nor Provincial disease control programs could operate. It is in the livestock producer's own interest to first make use of the services provided by the veterinary practitioner who will report to the Federal or Provincial Departments when necessary.

HEALTH OF ANIMALS DIVISION, FEDERAL DEPT. OF AGRICULTURE

An outline of duties and offices appears on Page **130.**

Common Diseases

The following disease tables provide a summary of the important disease conditions commonly encountered in Alberta. It is impossible to list all diseases. For example, approximately 200 different disease conditions are diagnosed in Alberta poultry yearly. Therefore, a veterinarian should be consulted. Satisfactory treatment and preventative measures depend upon an early and accurate diagnosis.

The laboratory services are free to all Alberta livestock producers. The majority of the material is submitted by practising veterinarians, who use the facilities to provide better and complete service for their clients.

DISEASES OF SWINE

DISEASE	DESCRIPTION	PREVENTION AND CONTROL
Losses in Suckling pigs	Greatest loss in first 4 weeks of life. Infectious disease is responsible for only a small part of loss. Vitamin and iodine deficiency in ration of pregnant sows, anemia, chilling from damp, drafty farrowing pens, poor sanitation all are important.	Follow recommended feeding and management practices for pregnant and nursing sows. Commercial preparations containing vitamin and antibiotics are available for the control of uncomplicated scours in nursing pigs. If losses occur despite good practices seek professional help.

DISEASES OF SWINE

DISEASES	DESCRIPTION	PREVENTION AND CONTROL
Anemia	Nursing pigs receive insufficient iron from sow's milk. If iron is not available nutritional anemia will develop, causing weak, pale, listless pigs, often accompanied by scours, heavy breathing, and death.	Iron must be administered commencing at the 2nd or 3rd day of life, repeated twice weekly for the first 3 weeks, has been found preferable in Alberta to 7 day intervals. Preparations available are reduced iron, paste pills, liquids, ferrous sulphate sprinkled on sods, and injectable iron.
Enteritis (Scours)	In animals 4-12 weeks of age. Diarrhoea may be a symptom but loss of weight and unthriftiness are characteristic. May be the result of infection but most often origin is in poor feeding practices, high fibre rations (oat hulls) and often complicated with heavy roundworm infestation.	Laxative of raw linseed oil (¼ cupful/100 lbs. of pig) and light diet gradually return to full feed. Antibiotic supplements helpful but not a substitute for good sanitation. Some cases necessary to resort to medicinal treatment with antibiotics or sulfonamides.
Roundworms	Most critical in small pigs. Adult in intestinal tract produces thousands of eggs which pass out in droppings contaminating pastures, yards and farrowing pens. Eaten by little pigs, hatch, grow to maturity after passing through liver and lungs. Unthriftiness and coughing are prominent symptoms.	Good sanitary practices, including pasture rotation yearly, worm free sows and clean farrowing pens essential. Practice routine worming program at 8 weeks of age with sodium floride, cadmium preparations or piperazine. Feed additives for parasite control are being developed; see swine production pages **109, 110** for directions re sodium fluoride and sanitation principles.
Erysipelas	Most serious infectious disease of swine. Observed most frequently in pigs over 100 lbs. but will affect all ages throughout the year. Three types, acute, chronic and diamond skin disease. The acute appears suddenly with high fever, pigs prostrate and dying; spreads rapidly. Chronic type is characterized by enlarged joints, crippling and unthriftiness.	Early recognition and prompt treatment essential in acute outbreaks. Consult your veterinarian. Penicillin and erysipelas antiserum used in treatment with serum being administered to all exposed pigs; routine vaccination at 8 weeks with erysipelas bacterin from May to October at least.
Virus Pneumonia	Virus disease characterized by persistent coughing and varying degrees of unthriftiness. Most important in that it may result in severe secondary pneumonia precipitated by improperly ventilated quarters.	No effective treatment available. Good housing particularly for young pigs will control losses. Vaccination may be helpful where secondary pneumonias are a recurring problem.
Rhinitis	Infectious disease appearing first in nursing pigs causing sneezing, occasional bleeding from the nose with the gradual development of deformed, twisted or shortened snouts. Not all pigs of a litter may be affected but all are potential carriers. May affect a large number of pigs but becomes chronic with fewer animals showing symptoms.	No curative treatment. Care in purchase of stock, only from rhinitis free premises. In majority of cases it is necessary to market all pigs and start again with clean breeding stock.

DISEASES OF SWINE

DISEASES	DESCRIPTION	PREVENTION AND CONTROL
Pneumonia	Infectious disease, most frequent in colder seasons of the year, with fever, rapid breathing and varying number of animals affected.	Sick pigs isolated and treated with antibiotics or sulfonamides; avoid damp quarters; vaccination with pneumonia bacterin an aid in control.
Glasser's (Infectious) (Serostiis)	Infectious disease not completely understood. Frequently observed as a disease in litters, vigorous to 3 weeks of age at which time they begin to do poorly. Coughing, a few enlarged joints, heavy breathing and stunted growth in survivors is characteristic.	Terramycin and some other antibiotics are successful treatment. It is best to consult your veterinarian since it is necessary to follow management practices designed to eliminate or control the infection.

DISEASES OF CATTLE

Vitamin A Deficiency	Deficiency observed as weak calves, scours, convulsions and death; blindness and collapse in feed lots.	Adequate amounts of vitamin A in ration of pregnant cows; good quality roughage. The use of commercial vitamin A supplements (to supply 30,000 I.U. vitamin A daily) for pregnant cows and feedlot animals can be highly recommended.
Mineral Deficiency	Commonly observed in Alberta particularly phosphorus deficiency in cows with depraved appetite, loss of condition and breeding deficiencies.	Mineral supplements must be used. Expensive complex preparations are not necessary — Don't forget salt.
Calf Scours	**Beef** — almost invariably related to vitamin A deficiency. **Dairy**—vitamin A is important but infection from contaminated surroundings and improper management practices are factors; will establish itself as a highly infectious disease in a herd.	Follow recognized feeding and management practices; good sanitation in dairy barns. Commercial calf scours preparations (containing antibiotics and sulfa drugs) are available. Vitamin A is helpful in treatment.
Bloody Diarrohea Coccidiosis	Infectious disease observed most frequently in young beef animals in colder seasons of the year characterized by bloody diarrohea.	Suspected diagnosis should be confirmed; sulfonamides or intestinal astringents are used in treatment.
Indigestion	An acute toxemia with depression — coma and death; result of a sudden change of feed, switch to new grain, animals gaining access to open bins or granary. In severely affected animals the outcome is almost always fatal.	Try to avoid circumstances which cause it. Get professional help. The administration of oil, forced exercise and restricted water intake may be helpful.
Bloat	**Acute** — rapidly developing fatal bloat occurring on lush pasture, particularly legumes. **Chronic** — observed most often in individual beef animals; not usually immediately fatal. There is still much unknown concerning the true cause of bloat.	Avoid turning hungry cattle on to young lush legume pasture particularly if it is wet. Kerrosene in milk, the placing of a gag in the mouth or puncturing the rumen (left side) with trocar and canula in acute cases; treatment of chronic bloat not often successful.

DISEASES OF CATTLE

DISEASES	DESCRIPTION	PREVENTION AND CONTROL
Blackleg	Acute infectious disease of young cattle between ages of 4 months to 2 years; occurs most frequently on pasture but may occur throughout year in animals of all ages. Animals often found dead, carcass bloated; gassy swellings underneath the skin are often a prominent feature.	Vaccinate calves and yearlings routinely with blackleg-malignant oedema bacterin. Calves should be 4 months of age if good protection is to be afforded.
Malignant Oedema	Very similar to Blackleg.	As for blackleg.
Clostridium Perfringens	Not completely understood; disease entity very similar to Blackleg. May cause sudden losses in nursing calves, scours and convulsions; not to be confused with vitamin A deficiency.	Professional help is required for accurate diagnosis—Perfringens bacterins are successful in control; antitoxins for treatment.
Shipping Fever	An acute suddenly occurring infectious disease of beef cattle usually associated with shipping. High fever, pneumonia, sometimes scours are characteristic.	Try to avoid rough handling. The use of vaccines two weeks prior to shipping may be helpful. Obtain qualified advice in the handling of outbreaks.
Mastitis	Infection of udder of dairy cows with development of flakes, clots and blood in milk; acute flare-ups on occasion with swollen udder. Irritation and damage to udder is a factor in cause.	Follow milking practices and management designed to control mastitis. Early treatment is essential. Don't waste money on repeated treatment of individual cows. Mastitis control programs are available through your veterinarian.
Brucellosis	Infectious disease, causing abortion sterility, retained afterbirth, and transmissible to man. Infected cow main spreader.	Calfhood vaccination, blood testing and elimination of infected cows. Control programs sponsored by both Federal and Provincial Governments.
Vibriosis	Infectious disease characterized by early abortion and repeated breedings. Cows recover but the infected bull, the main spreader, remains so indefinitely.	Must be diagnosed by a veterinarian. Elimination of infected bulls; use clean bulls on clean cows—artificial insemination, if practical. Herd control programs are successful.
Cancer Eye	White faced cattle, small sore on eyelid which will continue to grow until animal dies or is killed.	No treatment, early salvage by slaughter. Surgery may be successfully performed on valuable animals.

DISEASES OF SHEEP

Stiff lamb disease	Nutritional disease in lambs 3-10 weeks of age, particularly in early lambs; stiffness of hind-quarters developing into paralysis and inability to stand; while exact cause is unknown believed to be nutritional in origin with restricted exercise a possible factor.	Administration of a teaspoonful of 10% phosphoric acid daily in milk is effective treatment. Vitamin E supplements are believed to be helpful in preventing the condition.

DISEASES OF SHEEP

DISEASES	DESCRIPTION	PREVENTION AND CONTROL
Weak Lambs Scours	Losses occurring in new born lambs, diarrohea, weakness, and death; not usually the result of infectious disease but of nutritional deficiencies, particularly vitamin A in ration of ewes during pregnancy.	Follow recommended feeding and management practices for pregnant ewes. Vitamin A supplements can be recommended; concentrated fish oil administered to weak lambs at birth.
Clostridium Infection (new born lambs)	Infectious disease appearing as yellow pasty diorrohea with rapid death and losses occurring despite good feeding and management practices.	The disease should be confirmed by consulting a veterinarian. The vaccination of pregnant ewes with a Type D Clostridium perfringens bacterin is indicated. The bacterin and antitoxin can be administered to lambs if indicated.
Internal Parasites Roundworms	Sheep are highly susceptible to a number of types of roundworms, all are serious parasites; in lambs the blood sucking stomach worm will cause heavy death loss; intestinal worms causing diarrohea and loss of appetite are often observed.	Follow a regular parasite control program; worm flock in January; repeat in early summer and fall. Phenothiazine is most popular treatment and can be mixed with salt for continuous administration.
Lungworms	Parasite that lives in lungs resulting in persistent coughing, unthriftiness, and death.	Treatment with commercial lungworm preparations — good sanitation important.
Tapeworms	Not as serious as roundworms; may cause symptoms of incoordination or staggering.	Require special treatment; phenothiazine is not effective; excellent commercial preparations available.
Enterotoxemia (Clostridium Perfringens)	Infectious disease observed most frequently in lambs on heavy feed; suddenly appearing convulsions, spasms and death; may occur in nursing lambs.	Good practice to vaccinate feeder lambs with a Clostridium perfringens type D bacterin routinely.

DISEASES OF POULTRY

List of Eight Important Diseases of Poultry in Alberta

DISEASES	DESCRIPTION	PREVENTION AND CONTROL
Leukosis Complex	A virus tumour type of infectious disease showing up in various forms, e.g., paralysis, enlarged livers, bones, etc.; spread by direct contact, aerosols and egg transmission; affects chickens mostly but can affect turkeys.	Control difficult — raising day-old birds at least 200 yards from old birds assists in reducing incidence.
Avian Tuberculosis	A bacterial infection similar to cattle and human types of tuberculosis; not highly transmissible to people, but highly transmissible to pigs; affects chickens and turkeys.	Sanitary management; no drug treatment effective.
Infectious Bronchitis	A rapidly spreading virus infection of lungs and windpipe of chickens; does not affect turkeys; can cause losses baby chicks; in adults loss of egg production.	Vaccinate chicks; revaccinate birds producing hatching eggs to ensure temporary parental immunity to offspring.

DISEASES OF POULTRY

DISEASES	DESCRIPTION	
Coccidiosis	An intestinal disease caused by tiny microscopic protozoan parasites called coccidia. These break down the cells of different parts of the intestinal tract; different types affect turkeys and vice versa.	Maintain litter and surrounding of birds in a dry condition; the use of commercial coccidiostat in the feed or water recommended; several good drugs available for treatment; follow manufacturer's instructions.
Chronic Respiratory Disease	A chronic slow spreading infection of lungs, windpipe and air sacs in chickens; also cause swollen sinuses of the face in turkeys. Caused by a microscopic organism called P.P.L.O. possibly with a virus assisting it. Very chronic in nature, "handing on" in a flock through the life of the birds. Sometimes noticeable as a sneeze or cough and low egg production; may cause fairly high losses in broilers; transmission from bird to bird or through eggs.	None really effective to date. Administration of antibiotics assist in "holding down" symptoms but generally do not cure it; much hope held for the production of P.P.L.O.-free breeding flocks.
Enterohepatitis (Blackhead)	A highly fatal liver and intestinal infection of turkeys and chickens caused by tiny microscopic protozoan parasites called Histomonads. These generally infect by "hiding" in the body and eggs of the common caecal worm of chickens. Chickens have some resistance but turkeys are highly susceptible.	Do not raise chickens and turkeys together. Proper range rotation to eliminate worm eggs. Attempt control by drugs fed continually in the feed; this is still very expensive; good drugs available for treatment.
Fowl Typhoid	A serious bacterial infection of poultry (chickens, turkeys, ducks, geese, etc.); generally associated with poor sanitation; mostly affects adult birds. Transmission is by direct contact carrying infected manure from farm to farm; or through eggs; in Alberta has been confined to the area east of Edmonton.	Good poultry sanitation; rotate ranges, keep birds away from their droppings; use clean disinfected laying houses; good roosts and dropping board construction. Restock with day-old chicks only from approved hatchery; drugs available for treatment.
Pullorum	A generalized bacterial infection killing mostly baby chicks and poults, transmitted by direct contact or through the eggs.	A continent-wide blood testing program has greatly reduced the incidence. Restock with only day-old chicks from an approved hatchery where all eggs are set from pullorum and Fowl Typhoid tested birds; drugs available for treatment.

POISONINGS

A considerable number of cattle, swine and other livestock are lost each year. Many such losses can be avoided if potential dangers are recognized and known harmful substances properly handled. In most cases healthy animals will sicken or die suddenly with an observable period of illness. Diagnois is established by the demonstration of the poison in the stomach and organs of the animals. A verterinarian should perform the post-mortem in order that specific changes may be noted and proper material is collected. This is most important if there is a possibility of damage claims. The commonly encountered poisons are listed below.

(a) **Plants** —usually when normal forage is in short supply; — water hemlock, larkspur, algae (water scum) death camas, loco weed, nitrate poisoning (oat hay).

(b) **Chemicals** —lead, arsenic, sodium chlorate, mercury, nitrates. Agricultural chemicals, including insect sprays, some weed sprays, some wood preservatives. and livestock sprays are dangerous if used carelessly.

(c) **Waters** —chemically unsuitable waters do not often cause death but they will seriously affect the health of animals. The presence of the following substances in amounts indicated and greater are unsuitable:—

Sodium chloride (salt)	50 grains per gal.
Sodium sulfate (Glaubers salts)	100 grains per gal.
Magnesium sulfate (epsom salts)	100 grains per gal.
Sodium carbonate (soda)	100 grains per gal.
Iron	0.3 parts per million
Nitrates	5.0 parts per million

Water supplies can be checked by submitting a sample in a clean sealer to the Veterinary Laboratory. There is no charge.

PREVENTING LIVESTOCK LOSSES

Practical points of livestock production which are important in preventing disease losses.

SWINE

1. Care in purchase of breeding stock. Buy only from disease-free premises.
2. Follow accepted practices in feeding and management of pregnant sows.
3. Provide farrowing quarters that avoid draughts and dampness in the colder seasons of the year and which can be readily cleaned and disinfected.
4. Creep feed and starter rations are important.
5. Follow a routine worming program, combined with good sanitation and pasture rotation.
6. Innoculate routinely with erysipelas bacterin at 8 weeks of age, particularly from May to October.
7. Never feed meat scraps, table scraps, garbage or offal to swine because such products may carry bacteria and virus that are the cause of some serious swine diseases. It is illegal to feed collected garbage or offal without a permit from the Veterinary Director General, Confederation Building, Ottawa, Ontario.

DAIRY CATTLE

1. Calfhood vaccination for control of Brucellosis.
2. Good management practices as applied to the feeding and housing of calves.
3. Follow a program designed to prevent and control mastitis. Good sanitary milking practices, udder care, the routine use of a strip cup, and a sponsored mastitis control program if indicated.
4. Innoculation of calves and yearlings with Blackleg, Malignant oedema bacterin before pasture season.

BEEF CATTLE

1. Calfhood vaccinations for Brucellosis control.
2. The supplementation of diet of pregnant cows with vitamin A and mineral to ensure a healthy calf.
3. The innoculation of calves at branding and weaning and yearlings with Blackleg, Malignant oedema bacterin.
4. Innoculation of calves and yearlings revaccinated for Blackleg and Malignant oedema and probably Clostridium Perfringens Type D.
5. A Pasteurella (pneumonia) bacterin can be used in the fall as additional protection against pneumonia.
6. Mineral supplements to pasture cattle will eliminate some of the commonly occurring sterility problems.

SHEEP

1. Adequate feeding of pregnant ewes with vitamin supplements to ensure healthy lambs.

2. Follow a routine worming program, with administration of phenothiazine in January, early summer and fall.
3. Innoculate feeder lambs with Perfringens Type D bacterin.

POULTRY

Do

1. Purchase day-old chicks or poults from an approved hatchery.
2. Brood chicks or poults in clean, disinfected brooder house.
3. Feed chicks only a good commercial or recommended chick starter. Feed poults only a good commercial or recommended turkey starter. No other feed should be necessary until the birds are six to eight weeks old, then give growing mash (see feeding).
4. Put birds onto good green range when ready. Fresh range should be used each year (see Range Rotation). Range should be well away from barn yard.
5. In the fall bring hens into clean, disinfected laying house.
6. Keep litter in hen house dry.
7. Use proper roosts and screen off droppings under roosts.
8. Use sanitary feed and water troughs—with covers or spinners on top to prevent droppings getting in with feed and water.
9. Raise feed and water troughs at least one foot off the floor.
10. Bury all dead birds or throw in toilet.
11. Fill in all low or damp spots on the range or fence them off.
12. Control lice—with lindane, malathion, and nicotine sulphate. Malathion can be applied to birds but not lindane or nicotine sulphate which should be painted on roost.
13. Control mites—with lindane, malathion, D.D.T., or Kerosene and crank case oil.
14. Sell off the old flock in the spring, after peak egg production is over — and clean and disinfect the hen house.
15. If you have birds die—find out why! See your veterinarian.
16. Check on your management. See your Poultry Inspector or District Agriculturist.

Don't

1. Don't run chickens and turkeys together as it's only a matter of time before you run into trouble.
2. Don't run poultry and pigs together—keep them all separate as they can get disease from one another, especially tuberculosis.
3. Don't throw dead birds to the pigs.
4. Don't throw dead birds on manure piles — bury them.
5. Don't let poultry get onto the manure piles.
6. Don't overcrowd birds. Allow four square feet of space for each hen.
7. Don't let poultry run all over the barn yard. Have a place for them and keep them there.
8. Don't fertilize poultry or hog ranges with poultry manure.
9. Don't let visitors into your poultry pens and yards unless they wear clean rubber boots.
10. Don't feed grain on the floor or ground.
11. Don't bring dirty crates or equipment into your farm.
12. Don't go into a neighbor's poultry pen —especially if he has sick birds. If you must — disinfect your shoes or boots before you go to your own flock.
13. Don't feed birds the insides of dressed chickens or turkeys.

HEALTH OF ANIMALS DIVISION, CANADA DEPARTMENT OF AGRICULTURE

This Division contains three sections, namely Contagious Diseases, Meat Inspection and Animal Pathology. The function of the Contagious Disease Section is to regulate the importation of livestock and livestock products to prevent the introduction of animal diseases. This section issues and endorses export health certificates. This section also takes action on reportable diseases and carries out area testing programs for Tuberculosis and Brucellosis.

The Meat Inspection section operates under the Canada Meat Inspection Act. The Animal Pathology section does research, make products such as tuberculin and does some diagnostic work.

This Division is under the Veterinary Director General at Ottawa, Ontario. There is a district office at 403 Public Building, Calgary, and there are sub-district offices at Brooks, Calgary, Camrose, Consort, Coutts, Drumheller, Edmonton, Fort Macleod, Grande Prairie, Lethbridge, Medicine Hat, Peace River, Red Deer, Stettler, Vermilion and Wetaskiwin. At these centres most of the offices are located in the Post Office building.

The Meat Inspection staff have an office at each plant operating under the Canada Meat Inspection Act. In Alberta the Animal Pathology section have a laboratory at Lethbridge.

SOME REPORTABLE DISEASES IN ALBERTA

DISEASE	SPECIES AFFECTED, CAUSE AND SYMPTOMS
Hog Cholera	A virus infection that causes a high mortaility in hogs; high fever, off feed, disinclined to move, weakness and diarrhea.
Anthrax	A bacterial infection of horses, cattle, etc.; swelling of throat or other parts; temperature rise; blood from nose or mouth, usually quick death.
Mange (scab)	A parasite (mite) infestation of horses, cattle and sheep; excessive itchiness, loss of hair or wool.
Scrapie	A nervous disease of sheep and goats with great itchiness; restlessness, excitable, grinding of the teeth; scratching of itchy spots causes tremor or smacking of the lips; finally animal weakens and dies.
Others:—	Foot and Mouth Disease, Rinderpest, Rabies, Fowl Typhoid, Newcastle Disease, Vesicular Exanthema of Swine and other diseases that may be introduced from foreign countries.
Action:—	If any of the above diseases are suspected, contact nearest sub-district office, district office at 403 Public Building, Calgary, or a veterinary practitioner who is required by law to report to Federal authorities.

APPLYING INSECTICIDES TO CONTROL LIVESTOCK INSECTS

Modern insecticides, properly used, will control most insects attacking livestock. Insect control will increase weight gains, grade of carcass, milk flow, and health of animals generally. It is essential for profitable livestock production in small farm herds as well as large ranch herds.

Satisfactory control can be obtained in small herds by farmers without costly equipment. Community action is recommended to control houseflies and warble flies.

Insecticides can be applied as sprays, washes, dusts and bacline applications.

For spraying cattle with long hair coat the sprayers must: (1) be capable of maintaining pressure up to 500 pounds per square inch, and be able to deliver at least four gallons per minute; (2) be equipped with a mechanical agitator in the tank, and adequate strainer between the tank and the pump, and suitable drain cocks for draining pump and tank.

High pressures are necessary for livestock insecticides to penetrate the hair. The chemical must reach the skin to control warbles and lice, and break down the scab to control warbles with rotenone. Universal type sprayers are most suitable and are available at reasonable cost.

When using wettable powders in spray machines, special precautions should be taken to see that the pump is thoroughly washed after each use. Such materials should never be left in the tanks over night.

Single nozzle adjustable spray guns are most satisfactory for treating warble grubs in the backs of cattle. Triple nozzle spray guns are most suitable for spraying animals for cattle grub and louse control, barns and other buildings for fly control, and farmsteads for mosquito control. Fan-type guns can be used for warbles, lice, and other livestock insect control work.

Self applicators (back rubbers) for applying chemicals to livestock are very satisfactory for control of horn flies. They are of doubtful value in the control of other biting flies (horse flies, deer flies, mosquitoes, black flies, etc.), and lice. They have no value in the control of warbles.

Suitable applicators may be cheaply made with materials available on any farm. Several strands of barbed wire may be loosely twisted together and wrapped with old sacking, until a roll about six inches in diameter has been completed. This is then tied tightly every four to six inches with heavy cord. This roll may be attached to two posts placed a rod apart. It should be fastened four to five feet above the ground at the posts, and allowed to sag within a foot of the ground in the centre. It should be soaked with a five percent solution of DDT or methoxychlor in a suitable solvent. (Solutions suitable for use with applicators can be secured from most chemical companies.) Solutions containing DDT should not be used (where the rubber is) for dairy cattle. This applicator will require about one to 1½ gallons of mixture. It will be necessary to moisten it with additional chemical at about weekly intervals. Repairs can be made with additional old sacking and cord. There are many other ways of making such a roll and other methods of attachment to posts. Any method which provides a suitable absorbent

roll and allows the animals to treat themselves is satisfactory. The rubber should be located near the water supply or salt block or any area where cattle loaf.

Sanitation — Failure of insecticides to control certain insects, particularly houseflies and stableflies, occurs most often because of lack of sanitation, and not so much because of the insect's resistance to the insecticides. If manure, litter, and other breeding places are not cleaned up the insects may appear in too large numbers for insecticides to control.

SANITATION IS ESSENTIAL

Livestock should not be fed on insecticide-treated plants until danger from poison residues is past. The required interval between treating the plants and pasturing or cutting them for feed is given on the labels of the insecticide and should be adhered to in the interest of animal and public health.

IF POISONING OF LIVESTOCK BY INSECTICIDES IS SUSPECTED CALL A VETERINARIAN

Symptoms are in general similar for most animals. They are: nervousness, wild stare, tremor, slobbering, diarrhoea, loss of appetite and weight, paralysis and convulsions. Animals in poor condition are more susceptible to poisoning by livestock sprays than those in good condition.

SYMPTOMS OF POISONING

By Dieldrin, Aldrin, Hepatchlor, Chlordane, Lindane (BHC), DDT, and Toxaphene

Symptoms of poisoning may appear in as little as 15 minutes and usually within 24 hours after exposure.

An affected animal will generally first become excitable and more alert to its surroundings. Twitches of various muscles follow, usually beginning at the head and moving back along the body. The twitches may increase in intensity until there are spasms and finally convulsions.

The animal may also assume abnormal attitudes, such as standing with the head between the forelegs and under the body or in a sternal position.

There may be persistent chewing movements. Occasionally the animal attacks any moving object. Usually there is profuse salivation, dyspnea (difficult breathing), rolling of the eyes, dribbling of urine, and bawling. The body temperature often reaches 114 - 116° F.

Some animals show none of these active symptoms. Instead, they become depressed and unaware of their surroundings. Others are alternately depressed and excited.

Severity of symptoms is no index of the likelihood of death or survival. Death may occur in less than an hour — or several weeks after exposure. Most cases run their course within 72 hours.

SYMPTOMS OF POISONING

By Parathion, Malathion, Neguvon, Trolene FM40, Co-Ral, Ruelene, and other organophosphates

The symptoms of poisoning by these compounds resemble those described above, although there may be some variations from animal to animal. Poisoned animals first show excessive running from the mouth and the eyes, followed by general dullness and depression. The animals shiver and have little inclination to eat or drink. They have difficulty in breathing and walk stiffly with incoordination of the hind legs. Some animals lie down and appear paralytic. In acute cases death occurs from respiratory failure.

INSECT PESTS OF LIVESTOCK AND POULTRY

INSECT	NATURE OF DAMAGE	CONTROL
Lice (of cattle)	Biting lice feed on skin surface and irritate animals. Sucking "blue" lice, common in winter, suck blood, reduce milk yields and weight gains, cause rash, severe irritation and anemia. Lousy animals get thin and may die. Lice begin to show up in the fall as dark patches where the hair is thin, particularly along the underline. A lousy animal has greasy patches of hair and an odor of stale blood. Eventually the hair is rubbed off in patches.	Wash, dust or spray with malathion; Co-Ral, Korlan, lindane, DDT, Ruelene, Chlordane, toxaphene, methoxychlor or rotenone according to the instrutions on the labels of the insecticides. Chemicals must reach skin. When spraying the operator should hold the gun within 12 inches of the animal's body. Fall treatment is preferable. Where cold weather treatment is required, use a dust.

INSECT PESTS OF LIVESTOCK AND POULTRY

INSECT	NATURE OF DAMAGE	CONTROL
Cattle Warbles (Heel flies or gadflies)	Warble flies worry and frighten animals when laying eggs on legs and lower part of body. This causes gadding which reduces milk yields and weight gains. Grubs in animals reduce milk and meat yields and carcass grades, and cause unthriftiness, and injury to hides. Contrary to general belief, warble flies cannot bite or sting.	Community action is recommended but single-farm control can be effective. Cattle grubs can be killed before they form warbles in the back by treating the animals with systemic insecticides — the compounds that are absorbed by cattle and passed on to the parasites. Treat with Co-Ral, Ruelene or Trolene FM40 according to the instructions on the label. For cows in milk use rotenone powder (warble powder). These insecticides will control cattle lice also. TIME: Only one treatment in the fall is necessary with sytemic insecticides. Read the label for the timing of treatment. METHOD: Co-Ral and Ruelene are used as sprays or pour on applications, and Trolene FM40 is given in feed. Apply acording to the labeled instrutions. If sprayed, these chemicals must reach the skin. While using rotenone for warbles in the backs of cows in milk or other animals, scrub, wash or rub the powder into warble holes. Spray one-half gallon per head of 0.05% rotenone under 400-500 pounds pressure with a single nozzle gun fitted with a 5/64-inch disk.
Houseflies	The house fly carries and spreads diseases and parasitic worms of man and animals. The maggots are found in manure, garbage, and other decaying materials.	Sanitation is essential. Clean up breeding places in barns, feed-lots, garbage, and privies. Treat privies with chloride of lime. Spray manure piles with malathion. Spray interior and exterior of barns, chicken houses, privies, etc., with DDT, methoxychlor, lindane, Korlan, diazinon, dibrom, or malathion. Household residual sprays or pyrenone space sprays are available. Poison baits may be used. If a power sprayer is used limit the disc opening to 4/64 inches.
Hornflies	Irritation and loss of blood caused by small, dark grey, biting flies clustering behind the shoulders of cattle. Sometimes attack sheep and horses. Mainly July - August.	Spray backs of animals with 1 lb. 50% wettable DDT or methoxychlor in 10 gals. of water or with pyrenone livestock spray or one gallon 50% emulsifiable malathion per 100 gals. Do not use DDT on dairy cows, or on any animals within one month of slaughter. Power sprayers or back rubbers may be used for range animals.

INSECT PESTS OF LIVESTOCK AND POULTRY

INSECT	NATURE OF DAMAGE	CONTROL
Stable Flies	Painful bites, loss of blood. May transmit disease.	Eliminate breeding places; spread manure and wet litter, plow under stack bottoms. Spray barn interior with residual insecticide — (see houseflies) spray animals as for horn flies.
Black Flies ("Sand Flies")	Feeding by small hump-backed, greyish flies on thinly-haired parts of animals, particularly cows and bulls, causes loss of blood, soreness, swellings, serious illness or death within a few hours of first mass attack late in May or in June. Milk production may be reduced. Swarms of killing species come mainly from rocky rapids of fast flowing rivers. Less dangerous, but highly troublesome species, emerge from other rivers.	Watch carefully for dangerous swarms of these flies particularly in late May and in June; as soon as any appear stable valuable animals, particularly bulls. Small swarms may occur throughout the summer. Use smudges to protect animals that cannot be stabled. Serious damage is most common within 50 miles of fast flowing rivers. Some relief may be obtained by spraying animals as for mosquitoes.
Mosquitoes	Worry and loss of blood. May transmit disease. Mosquitoes breed mainly in temporary pools, in weedy roadside ditches, permanent sloughs, and pasture depressions.	Drain breeding places in entire community, or kill larvae soon after pools form in the spring with a film of oil, with or without DDT added (1/10 to 1/4 lb. per acre). To kill adults use a residual spray of DDT wettable powder on vegetation and buildings to a height of 10 feet. Pyrenone livestock sprays, smudges, or commercial fly repellents will give some relief.
Horse Bots (and nose flies)	Flies annoy animals while laying eggs on lips, throat, and legs Young grubs enter the mouth and grow there for a month; then are swallowed and cling to wall of stomach and intestine, sometimes causing death. These flies cannot bite or sting.	Provide darkened shelters for pastured animals. Use nose muzzle and under-jaw protection. Before December 15, mix 2/5 oz. (dry weight) Neguvon concentrate in feed per 1,000 lbs. of animal or treatment by veterinarian with carbon bisulphide capsules.
Horse Flies (Deer flies, Bulldogs)	Painful bites, loss of blood, and unrest gadding in cattle. May trans mit disease.	Provide darkened shelters for animals. Use pyrenone livestock sprays. Fly nets or coverings may help.
Sheep Keds (miscalled sheep ticks)	Brownish, flattened, tick-like insects about ¼ inch long. Pollute fleece and reduce vitality due to loss of blood and irritation.	A week after shearing thoroughly wet all sheep by spraying at 250-400 p.s.i. in a crowding pen using 5/100% lindane or ½% toxaphene, malathion or methoxychlor. In cold weather dust by hand with commercial rotenone dust.
Ticks (not to be confused with sheep keds.)	Ticks fasten themselves to most animals running on infested scrub-covered pastures and ranges, particularly in May and June; suck blood, causing weakness. May transmit diseases, such as Rocky Mountain spotted fever and tularaemia.	Destroy rodents on ranges. Keep animals off infested areas. Spray infested animals with toxaphene or lindane. Individual ticks may be picked off by hand. Mostly confined to the south of the Province.

INSECT PESTS OF LIVESTOCK AND POULTRY

INSECT	NATURE OF DAMAGE	CONTROL
Lice (of sheep, goats, and hogs.)	Irritation, rash, loss of hair or wool.	Spray at least at 250 lb. pressure with 5/100% lindane, ½% toxaphene, malathion or methoxychlor in a crowding pen. Treatment and precautions as for cattle lice. In cold weather dust by hand with commercial dusts. Rotenone is poisonous to hogs.
Lice of poultry)	Chickens appear dopey and listless; egg production falls off.	Clean out poultry house, then spray roosts, floor and nests with ½% lindane or malathion, or 40% nicotine sulphate. Then dust birds by hand with 4% malathion at 1 lb./100 birds or with commercial rotenone dust.
Mites of poultry)	Scaly leg mite feeds on blood. In time may cripple bird.	Soak legs in soapy water to loosen scales, then paint legs and feet with 1/10% lindane, or apply crude oil or equal parts kerosene and raw linseed oil. Spray roosts as for lice.
Northern fowl mite	Northern fowl mites remain on birds and congregate at the vent and neck where they suck blood.	Spray roosts and nests as for lice. Dust birds with 4% malathion dust at 1 lb./100 birds.
Mange and Scab Mites	Attack horses, cattle, swine and sheep. Irritation causes animals to rub and scratch; scabs form in advanced stages, and there is a loss of hair or wool.	When on horses, cattle, or sheep, must be reported to the Health of Animals Branch immediately. When on hogs, scrub, or spray at 350-400 pounds pressure, premises and animals with lindane using 1 pound 50% wettable powder in 100 gallons of water. Two scrubbings or sprayings are necessary at 10-12 day intervals. Clean up infested premises.
Mites of poultry)	Roost mites suck blood at night; on roosts and walls in daylight.	Spray roosts, walls and nests as for lice with ½% lindane or malathion.
Fleas (of animals and birds)	May carry disease and tapeworms. Adults small, dark, shiny, jumping insects. Larvae up to ¼ inch long; in bedding.	Thoroughly clean floors, carpets, and especially the sleeping quarters of dogs and cats. Then spray or dust quarters and dust animals with methoxychlor, rotenone, or malathion. Rid dogs and cats of fleas with dusts containing rotenone, methoxychlor, or pyrethrum.

Use livestock insect poisons according to directions on the containers.
Do not use household or oil solutions on livestock.
Carefully observe precautions for humans.

REFERENCES :
Department of Agriculture, Edmonton.
Publication No.:
84—Bang's Disease
136—Blackleg and Allied Diseases
112—Bloat in Cattle and Sheep
14—Diseases of Suckling Pigs.
12—Infectious Rhinitis
26—Mastitis—Prevention and Control
89—Rabies
88—Shipping Fever of Cattle
116—Swine Erysipelas
13—Swine Parasites
138—Vibriosis
31—Coccidiosis
29—External Parasites of Poultry
24—Infectious Bronchitis and Newcastle Disease
30—Internal Parasites of Poultry
28—Tuberculosis of Poultry
32—Respiratory Diseases of Poultry

Beekeeping

Beekeeping in Alberta falls into three categories, commercial, sideline and hobby. Commercial beekeepers whose major income is derived from bees operate at least 300 to 400 colonies. Sideline beekeepers supplement their regular income with from 40 to 200 colonies, while hobbyists keep from 1 to 25. An average production of 100 to 125 pounds of honey per colony may be expected in most areas with fair management. The price of honey has provided satisfactory investment returns.

Everyone keeping bees is required by law to register the number of his colonies and their legal land location, with the Apiary Branch, Alberta Department of Agriculture, Edmonton. There is no registration fee but annual registration is required.

Before attempting beekeeping, consideration should be given to a few pertinent factors. A person should not be unduly affected by bee stings. Time should be available at the critical periods of management. A study of bee behaviour, management and disease control should be made.

Beginners should start with at least two packages of bees. Any beginner considering beekeeping as a commercial enterprise should spend at least one season with an established beekeeper. Observations can then be made and losses due to mismanagement avoided. Nectar producing plants of the proposed area can be assessed to determine the optimum number of colonies to be operated.

The importance of visiting the Apiary Branch, District Agriculturist, Experimental Farm at Beaverlodge, Beekeepers and local beekeeping associations cannot be overemphasized.

EQUIPMENT

A sanitary, bee and fly proof building must be available for super storage and honey extraction. For every colony a hive cover, bottom board and five supers with 10 frames each are required for satisfactory operation. A bee veil, smoker, hive tool, gloves and coveralls are necessary personal items. The extracting equipment required depends on the number of colonies operated and can be best recommended by a bee supply house, the Apiary Branch, Department of Agriculture at Edmonton, or the Experimental Farm at Beaverlodge, Alberta.

To prevent the spread of bee diseases, specifically American Foulbrood, all used bee equipment must be inspected and a permit issued by the Apiary Branch, before such equipment may be bought or sold. In purchasing used bee equipment it is advisable to demand an inspection certificate.

MANAGEMENT

Almost 95 per cent of colonies in Alberta are from package bees imported from California. Although bees can be wintered successfully with adequate stores, good laying queens and proper care, the number of colonies wintered is small.

The Italian strain of bees is most popular, although hybrids and Caucasians are preferred by some. Two-pound packages with a queen generally are ordered in February or early March from a reputable supplier like the Alberta Honey Producers' Co-operative at Edmonton, or directly from the package bee shipper. Packages should arrive anytime during the month of April. Each brood chamber should have 20 pounds of honey or the equivalent in sugar syrup, and two to three frames of pollen. It is desirable to have a shelter to the north and west of the apiary.

Dandelion and willow provide nectar and pollen for spring build-up. Sweet clover, alsike, red clover, alfalfa, fireweed and rape are the main nectar secreting plants in Alberta. At least one acre of these plants per colony within a 1½ mile radius of the apiary is considered necessary for a satisfactory honey flow.

Colonies should be examined one week after installation for acceptance of queens, and to replace queens not accepted. Biweekly examinations until the middle of June will suffice, after which time until mid-July or later, colonies should be examined at least every 10 days for swarm control and provision of supers for the main honey flow. Honey may be extracted when the combs are two-thirds capped.

Colonies should be killed when the honey flow ceases, usually about the end of August, as unnecessary consumption of stores will reduce the honey surplus. The danger of granulation of honey in the comb, especially near rape fields, is more acute in September than in August.

POLLINATION

The value of bees as pollinators of legume seed crops far exceeds the value of honey produced. One-half to one colony per acre is recommended for clovers. Honeybees do not significantly increase the seed yields of alfalfa in Alberta although it is visited quite freely by the bees for nectar. Honeybees have been found to increase seed yields from Polish type of rape as much as 200 lbs. per acre.

Legume seed growers should make arrangements with commercial beekeepers to provide bees for pollination rather than attempt beekeeping themselves. Operating a large number of colonies conflicts with major farm operations.

DISEASES

Disease control is of utmost importance, and is the responsibility of every beekeeper. American foulbrood is the most serious. It kills the unhatched brood resulting in serious reduction of hive populations and unprofitable colony production. American foulbrood spreads from one colony to another and from one apiary to another if not controlled. European foulbrood is a less serious brood disease, but it too can reduce honey production.

Sac-brood, caused by a filtrable virus, is often prevalent in wintered colonies and less often in package bee colonies. Nosema, an adult bee disease is present in most colonies in varying amounts. It is worst in cool damp seasons. Any suspicion of disease in an apiary should be reported to the Apiary Branch, or to the nearest District Agriculturist.

MARKETING

The Apiary Branch prepares bulletins on marketing conditions periodically and these are sent out to all registered beekeepers.

Most commercial operators market their honey in bulk. Honey sold directly by producer to consumer does not come under marketing legislation; honey sold through retail outlets must have the name and address of the packer, the grade, and the class of the honey stamped or printed on the main label of the container. Grade is determined mainly by the water content and freedom from foreign material. Class is determined by color. Samples of a small amount of honey (about 1 ounce) may be forwarded to the Apiary Branch for grade and class determination. For complete regulations obtain a copy of the honey grading regulations from the Alberta Department of Agriculture at Edmonton.

REFERENCES :

Department of Agriculture, Edmonton.
"Beekeeping for Beginners in Alberta".
"Care of Package Bees".
"Package Bees, Their Introduction and Care".
Alberta Honey Producers' Co-operative, Edmonton.
"Hive and the Honeybee" Dadant.
"ABC and XYZ of Beeculture," A. I. Root.

Agricultural Engineering

FARM MACHINERY

Farm machinery should be selected and purchased on the basis of a definite need. Factors such as the potential saving in labor, capacity in terms of the need on the farm, and the availability of service should be considered in relation to price. Over-capitalization in machinery and equipment can be a serious fault in management. Field capacity can be estimated as follows:

$$\frac{\text{Width (inches) X miles/hr.}}{100} = \text{Acres/hr.}$$

The sizes of the field machines needed on the farm govern the size of the tractor that should be used.

TILLAGE MACHINERY

The primary objectives of tillage for dry land farming are moisture conservation, weed control and seed bed preparation. Secondary objectives include the control of erosion (both wind and water) insect control, and disease control. These can normally be obtained by selection of tillage equipment to accomplish the primary objectives. Land shaping, levelling and ditching are important operations in the irrigated areas. The quality of work will depend on soil moisture, and the condition and setting of the machine.

Tillage to a depth of 3 to 4 inches is normally recommended. It is rarely of advantage to till deep. Depth is measured by laying a straight edge on the unworked surface and measuring to the bottom of cut. The depth of operation is usually established by the first operation, with subsequent operations being the same depth or less.

Plows—The moldboard plow is one of the oldest tillage machines known and is still widely used for breaking hayland and to a lesser extent in stubble plowing. For efficient operation, the plow must be properly hitched and the shares must be sharp. It is important to use a moldboard suitable for the soil and type of plowing. (See "Tillage Machinery, Maintenance and Operation," **under References.**

Disc Plows—are used in heavy clay soils where the moldboard will not scour properly. The discs are set at an angle to assist penetration. Disc plows leave the soil somewhat rougher than the moldboard plow.

Disc Equipment includes disc harrows, discers and one-way discs. All disc type machines have a tendency to pulverize the soil and should be used with care where soil erosion is a problem. The maximum speed recommended is 4 miles per hour. The proper size machine should be selected to load the tractor at this speed.

The principal difference between the disc implements is in size and spacing of discs. Discs are available in deep or shallow concavity. Better penetration may be achieved by one or more of the following: adding weight, changing to narrower cut,

using deeper concavity blades or sharpening the blades.

Machines with wide disc spacing must be operated deeper to obtain a clean cut. Deeper penetration or narrower cut means greater power requirements, but gives a cleaner cut with any given machine. Proper hitching and correct adjustments at the wheels are necessary.

Disc breakage in stony ground may be reduced by one or more of the following methods—decreased speed, wider cut, less weight, removal of stones. (See "Tillage Machinery, Maintenance and Operation".)

Cultivators are the most adaptable of all tillage implements to soil conservation and erosion control. Included are duck foot, heavy duty, tool bar, and blade cultivators. Cultivators use shovels or sweeps that cut off weeds below the surface with minimum disturbance to the soil and surface trash. Vertical hitch adjustment should be set so that all shovels or sweeps operate at the same depth.

The duck foot cultivator consists of a rigid frame with the shanks usually fixed at a 9 or 10 inch spacing. The shanks may be in two or three rows. The latter gives better trash clearance than the former, but still not as good as heavy duty cultivators. The shanks are rigid with a trip mechanism, which allows them to swing back when striking a solid object. Shovels varying in design and width from 2" to 12" are available. Ten or 12 inch shovels are usually used for weed control.

Heavy duty and tool bar cultivators have heavy rigid frames and the shanks are constructed of heavy spring steel with spring cushion but no trip mechanism. The shanks are arranged in two or three rows and are usually adjustable to give different spacing. A 12" spacing with 14" or 16" sweeps is customary. Chisel points also are available. The heavy duty cultivator has sufficient clearance for most trash conditions.

Blade cultivators consist of one or more wide sweeps on a rugged frame that will clear any trash condition. The blade is wide and steep, depending on a tumbling action to shake soil from the roots. Speeds over 4 miles per hour are recommended. This machine is not satisfactory under wet conditions. (See "Blade Cultivators, Operation and Maintenance", **under References).**

Subsoilers—Working below the 6" depth is not generally recommended. Any advantages that may be gained are outweighed by the increased power cost.

Harrows—are available in types including stiff tooth, lever, spring tooth and oscillating. Harrows are used for starting weed growth, killing small weeds and packing after other operations. Care must be exercised where soil erosion is a problem as harrows have a pulverizing action. Oscillating harrows will work in very heavy trash and are effective for spreading dry straw.

Rear Mounted and Semi-Mounted Implements—are available with various types of quick hitches and hydraulic control. Depth control is generally satisfactory for the narrower machine that is fully mounted while the semi-mounted principle allows wider machines to maintain uniform penetration. Inter-changeability between makes may be a problem.

Row-Crop Cultivators—in single or multiple - row units are best used on tractors designed with adequate clearance and wheel-tread adjustment to meet the needs of the crop. The belly-mounted unit, hydraulically controlled, provides better vision and depth control and is more useful for close cultivation than is the rear-mounted tool bar type cultivator. A complete range of cultivator attachments should be available. These are: discs, knives, duckfeet, shields, and in irrigated areas, furrowing shovels. Hillers are available for potatoes. The drilling of straight, evenly-spaced rows and careful slow-speed operation of the cultivator provide quality tillage without damage to the crop. The width of the drill and the width of the cultivator should be balanced so that the cultivator is not required to span the guess-row.

Row-Crop Thinners—are primarily used for the mechanical thinning of sugar beets. Down-the-row thinners are available in either tractor-mounted or trailer types. The former is more easily held on the row. Mechanical thinners, equipped with spring-type heads, are useful for pre-thinning, weeding and crust-breaking operations, and when equipped with the proper thinner heads, are used for either partial or complete thinning of the crop. Successful use of the thinner is dependent upon a satisfactory initial stand of beets, the proper selection of thinner heads based on stand counts taken in the field before and after each operation, and careful operation of the machine.

Heavy Duty Disc Machines — may be offset, single acting or tandem, equipped with 26" - 30" discs that may be plain or notched. These machines are of heavy construction and with added weight may be used for breaking light brush or grassland. Power requirements are high.

SEEDING AND PLANTING EQUIPMENT

The selection of the proper type of seeder is governed by crops to be seeded, soil, climate and the type of farming. In areas where moisture conditions are most favorable to germination, packing after seeding is not essential. The standard high-wheel or low-wheel drill is suited to these conditions. However, the discer or one-way

seeder requires the use of a packer to ensure good soil to seed contact. In dry or semi-dry areas, packing is necessary for uniform germination, and a press-wheel-carriage drill, or a packer attachment for the wheel drill will provide this.

Disc Furrow Openers—are suited to the seeding of a wide variety of crops, including cereals, oilseed crops, and grasses, where there is plenty of soil moisture for germination. Under very dry seedbed conditions, disc openers tend to place seed in dry soil unless excessively deep placement is practised. Disc openers give uneven seed placement when used on very heavy trash.

Semi-Deep Furrow Openers — (hoe or shovel) mounted on a press-wheel carriage and in a gang arrangement designed to provide good trash clearance, are well suited for use in areas where trash cover farming is practised. The semi-deep furrow seeding principle designed into these drills permits their use on dry or semi-dry seedbed in which moist soil exists at a depth of about 4 inches below the surface. The spacing of the furrow openers varies from 8 to 10 inches in these drills.

Deep-Furrow Drills—are used primarily for seeding of fall-sown crops in dry areas. Furrow openers (shovel or large single disc type) spaced 12 or 14 inches apart can be operated at a depth of 4 to 5 inches with a resulting cover of about 2 or 3 inches of soil over the seed. Deep-furrow and semi-deep furrow drills should not be pulled at a high speed, as this throws an excessive covering of soil over the seed in the furrows.

Combination Grain and Fertilizer Drills —are now being produced and fertilizer attachments are available for most styles of seeders. Fertilizer distributing mechanisms, whether on the drill or employed as a separate broadcast spreader, should be carefully cleaned after use as fertilizer absorbs moisture from the air and then corrodes and binds the moving parts of the machine. Fertilizer should not be distributed through the seed cups of the drill because it is abrasive.

One-Way Seeders—The use of the seeder box attachment on the one-way disc and the discer for stubbling-in cereal grain has merit equal to that of other methods of seeding where annuals constitute the major weed problem. On medium to heavy-textured soils, one-way seeders perform equally with other types for seeding summer - fallow. Packing after seeding, proper seed spout adjustment, and the use of a medium to narrow-width cut are essential to the successful use of the one-way disc seeder. Rubber tires help maintain control of seeding depth.

Broadcast Spreaders — designed for the surface application of fertilizer and other materials, should be calibrated to provide accurate application of the material.

Seeders for Grass and Small Seeds — Grass seeder attachments are available for standard drills. These are designed primarily for metering fine seeds such as clover and alfalfa. Slow-speed drive attachments are available for some drills to reduce the speed of the feed-shaft. This speed reduction increases the metering accuracy for small seeds such as mustard, rape and clover.

Special seeder boxes mounted on a double gang packer give good results provided the seedbed has not been excessively packed before seeding. These units pulverize the soil surface, and the threat of wind erosion must be considered.

Row-Crop Planters — are designed to handle a wide variety of crops grown in rows. The proper seedplate must be used for each crop. The precision drill for sugar beets, should be pulled at a slow speed (about 2 m.p.h.) and the drill should be kept in good mechanical condition. High speed decreases the rate of seeding and disturbs the accuracy of seed placement. Rows should be as straight as possible to facilitate subsequent cultivation. Fertilizer attachments should be carefully calibrated, and the shoe or runner-type openers should be sharpened to maintain their original shape.

HARVESTING MACHINERY

Swathers—either pull type or self propelled, should lay a closely knit windrow of grain, which is supported on top of the stubble. For best support the stubble should be about one-third the height of the original grain but not over ten inches high. The canvas and reel speed should be equal to or slightly greater than the forward speed of the machine.

Pull Type or Self Propelled Combines— will handle all types of grain crops, grass seed, clover, rape seed, etc., provided the machine is adjusted correctly and the special sieves are used where necessary.

Principal Adjustments:—

1. Cylinder Speed for a 21" diameter cylinder should be in the range of 900 to 1200 r.p.m. for efficient threshing of most grains.
2. Concaves should be adjusted just close enough to the cylinder to remove practically all grain from the head. Avoid too close threshing as cracking will result and excessive broken straw will carry grain over.
3. The wind blast should be adjusted to hit the front 1/3 to 1/2 of the shoe and should be of sufficient velocity to lift all chaff clear of the sieve. This allows the grain to fall through the sieve instead of being carried over in the chaff.

4. The top sieve should be maintained well open so unthreshed heads will go through, but the straw will be carried off. The lower sieve should be set closer to carry off bits of unthreshed heads but allow the clean grain to fall through. The sieves must not be closed so tightly as to restrict air flow. See manufacturers' recommendations for further information and adjustments for special crops. (See "Harvesting Malting Barley," **under References.)**

Combine Attachments—The pick-up reel is made up of rows of rake-like fingers instead of bats and is very useful in badly lodged crops. The speed of the reel must be correctly adjusted.

Grain saving guards or pick-up fingers are useful for saving tangled and lodged grain but will not work effectively if the crop is weedy. Pick-up reels and pick-up fingers should not be used together.

Wind reels may be used to reduce shelling losses.

Recleaners are useful for removing weed seeds and cracked grain.

Straw cutters are available for most combines and will shred and spread the straw. Three to eight horsepower is required to operate these attachments.

Straw bunchers are available commercially, or may be made by the farmer. They provide an easy method of collecting combine straw for feed or bedding. (See "Methods of Collecting and Handling Combine Straw".)

Straw binding equipment that ties loose rectangular bales is available, and this equipment mounts on the rear of the combine.

A device that measures the grain by volume as it is threshed, is available.

Sugar Beet Harvesters — Several types of machines are available. Single-row units, tractor mounted and employing self-unloading trailer-carts, have a capacity of 3 to 5 acres per day. Daily capacity is strongly influenced by efficient use of hauling facilities and by harvesting conditions. Single-row machines have adequate capacity for 40 to 60 acres per season under most conditions. Growers producing less than 20 acres of beets per year should consider either joint ownership or custom operation to justify the expense.

Multi-row harvesters generally require two operations to top and lift beets. Economical ownership requires seasonal use on 60 acres or more.

Ground toppers and within-machine toppers should be operated at moderate speed of 3 to 4 miles per hour. High-speed operation can result in inefficient topping, poor root recovery, and excessive breakage of tap roots as a result of failure to drive on the row. High quality work requires careful adjustment of the machine.

Top-saving devices are available on most machines and, where tops can be utilized for feed, care should be taken to preserve quality. A side-delivery rake can be used to shift the windrows of tops to avoid trampling by trucks and the harvester.

Trailer-carts, equipped with a sorting table, or a sorting belt, are useful for the manual removal of clods, although extra labor is required. The use of the cart facilitates the integration of the harvesting and hauling of beets. Under muddy conditions the truck can be left on a firm headland and the beets taken in the cart to the truck. Under severe conditions a second tractor has been used to help move the harvester in the field.

HAY AND SILAGE MACHINERY

Forage crops may be harvested as dry hay or silage. Green oats or barley are frequently harvested as silage. The equipment and system used will depend on the size of operation, method of storage, climatic conditions and available labor.

Mowers — Power take off mowers are available in side mounted, drawbar mounted and trailing models with hydraulic or mechanical lift. Some models are available with "pitmanless" knives which are vibrationless. The development of the serrated knife has reduced the problem of knife maintenance.

The important adjustments are pitman and cutter bar alignment, and knife registration. The knife bar end of the pitman should have a lead of ⅛" to ¼". The outer end of the cutter bar should lead the inner end ⅛" for each one foot of cut. The knife sections should centre on (register) a guard at each end of the stroke. (See "Mower Repairs and Adjustments".)

Swathers—may be used for cutting and windrowing some hay crops. Self-propelled swathers may require special attachments for hay.

Rakes—Dump rakes may be used where hay is to be handled by sweep or hand. Where balers and forage harvesters are used, it is necessary to use a side delivery rake to form an even continuous windrow. Several types of rakes are available in power-take-off or ground drive. P.T.O. drive limits the selection of tractor gears, while ground drive may be operated in any gear and at any speed suitable to the conditions. The large wheel rakes and newer side rakes (variously called oval action or parallel bar) windrow with less movement of the hay than the older reel type of rake.

Sweep Rakes and Stackers — A sweep rake mounted on the front of a tractor may be used to collect hay and bring it to various types of stackers. The hydraulic-

ally operated sweep stacker has largely replaced the separate sweeps and stacker.

Stack Movers are available that will handle stacks up to 16 feet wide and 30 feet long, and up to 7 tons in weight. Stacks may be conveniently and economically moved over a considerable distance. It is suggested that two or more farmers share the cost.

Balers — provide an economical method of processing hay for shipment or long hauls but do not reduce the man hours of labor per ton. Balers are available to make round or rectangular bales. The bale weight varies from 30 to 100 pounds, depending on the material, size of bale and the tension of the bale chamber. Wire or twine tie models are available. Twine is cheaper and most commonly used, but wire is preferred for commercial handling. Balers may be engine or P.T.O. driven, or self propelled. For power requirements see the section on farm power.

A uniform windrow is essential for efficient and trouble-free baler operation. Moisture content should not exceed 20%.

Knotters are the most common source of trouble but will give satisfactory service if manufacturers' instructions for adjustment and operation are followed.

Bale Handling Equipment is available which will reduce manual handling of bales to a minimum. The cost of the more complete mechanical handling systems is high, but this cost is possibly justified where several hundred tons of bales are handled in a season. In stacking, a loose layer of straw should be placed in the ground to prevent rotting of the bottom layer. Keep stacks narrow and well topped.

Wafering and Pelleting Machines for long or chopped hay are available commercially and offer some advantages in handling feed. Wafers are generally considered to be over two inches in diameter with the length less than diameter while pellets are less than two inches in diameter with the length greater than the diameter. Density of wafers and pellets ranges from 15 to 40 pounds per cubic foot with 25 pounds per cubic foot being the best, considering palatibility to cattle and handling characteristics. Power requirements for making wafers and pellets are high and moisture content is critical but mechanical feeding is facilitated. These machines are expensive and not recommended at this time, except on a custom operation basis.

Forage Harvesters are available in three main types—reel type cutter, flywheel cutter and flail type. The first two have a cutting or chopping action which is adjustable for theoretical cuts from ½" to 4". The flail has more of a shredding action which does not cut the material as uniformly.

The conventional harvesters may be fitted with direct cut attachments for making silage, or pick-up attachments for picking up dry hay or silage. Flail machines cut the standing crop directly or some models will pick up a windrow, all without attachments. A corn head attachment is available for conventional harvesters to harvest corn for silage. Flail harvesters are not recommended for corn.

Chopped hay and silage should be stored near the feed area as it is not easily moved. Self feeding should be considered. Forage wagons and blowers plus the necessary tractor power are required to haul and store the material as it is chopped. Chopped hay may be stored in outside bins made of snow fence or similar material or may be blown into lofts or inside bins. Outside bins should be topped with long hay to shed water. Dry hay should not be cut into less than four inch lengths and should contain not more than 20% moisture.

Green hay cut for silage should have a moisture content of 65% to 75% when ensiled. Good silage may be made from forage cut to any length, but coarse material requires more packing. Forage may be windrowed and "wilted" before chopping or cut and chopped in one operation for ensiling. The choice of methods will depend on moisture content of the standing crop and climatic conditions. (See "Harvesting Machinery for Hay and Silage" and "Grass Silage for Alberta".)

SPRAYING AND DUSTING EQUIPMENT

Farm Sprayers can be obtained for either low-pressure - low-volume or high-pressure spraying. Low-pressure units are designed to apply sediment-free pesticides and are normally equipped with a gear pump or a roller-vane pump. High-pressure sprayers are designed to apply a wide range of chemicals, including wettable powders, and are normally equipped with a piston or plunger pump and a mechanical agitator.

Consider carefully the type of spraying to be done when purchasing a sprayer. The herbicide sprayer should not be used to apply an insecticide to a herbicide-sensitive crop. Use separate sprayers for herbicides and insectcides. In an emergency, when the herbicide sprayer must be used to apply an insecticide, decontaminate the sprayer as follows:

Flush out the sprayer with kerosene to remove traces of oil-soluble pesticides. Run a solution of warm water and household detergent through the machine and then flush with clean water. Fill the tank with a mixture of household ammonia and clean water (1 gallon to 100 gallons) and leave the mixture in the tank for 24 hours or

longer. Run the mixture through the machine and flush with clean water.

Dusters may be used to apply herbicides or insecticides in the dust form. They may be operated at somewhat higher field speeds than are used for sprayers.

For additional information on sprayers and dusters, see the sections: "Crop Insects", page 81 and "Livestock Diseases and Pests," page 131.

OTHER FIELD MACHINES

Rotary Mowers are power take off operated and may be used to cut and shred weeds, brush and tree growth up to about 1½" diameter. Power requirements are not excessive. Protective shields must be used to prevent injury and damage from the rotating blade and flying pieces of wood.

Stone Pickers operate satisfactorily on stones under 10" diameter if they are on the surface and the soil is dry, firm and devoid of trash.

Farm Wagons, Trailers and Racks are used for transporting hay, grain, bales, silage, etc., and are available commercially or may be built by the farmer. (See bulletin, "Farm Trailers, Wagons and Racks".)

MACHINERY FOR IRRIGATION

Ditchers—Three types of ditchers are: the fixed - double - wing, the adjustable-double-wing and the adjustable-single-wing. Double-wing units form field ditches without the preliminary use of a plough. A plough furrow is necessary with the single-wing unit. Two or three trips are required to form a properly shaped ditch with firm, high banks.

Float Levellers are used to smooth small surface irregularities on a field that is to be irrigated by gravity methods. They are equipped with either an automatic hydraulic control for the scraper blade or a mechanical linkage between the blade and gauge wheels or a gauge plate. It is frequently desirable to pull harrows behind the leveller to roughen the field slightly to help prevent soil drifting. Homemade levellers should be at least 20 feet long and not over 8 feet wide for good floating action. An 8-foot blade on a commercial unit requires at least a 4-plough tractor, while a 10-foot blade should be pulled by a 5-plough tractor.

Ditch Fillers—Tractor-mounted ploughs, mounted in-throw disks, and mounted grader blades can be used for filling field ditches before the crop is harvested. Mounted disk-type bedders have given good service for this purpose.

Scrapers—Small carry-all or bucket type scrapers, varying in capacity from one cubic yard and upwards, are useful for small earth-moving jobs on the farm. Major land-shaping and earth-moving projects usually justify the use of industrial equipment.

Sprinkler Irrigation Equipment—Many types of sprinkler systems are available. The conventional hand-move system usually costs less initially and is more adaptable than other systems. Most of the other types, including tractor-tow, wheel-move, rotating-boom, rotating-lateral, and stationary or self-propelled, large-volume, high-pressure, single-nozzle types, have been developed to reduce or eliminate field labor. All of these are considerably more expensive and most of them have other disadvantages, which may include: (1) considerable difficulty in moving the system from one field to another; (2) elaborate mechanisms more subject to breakdown; (3) increased pumping costs in the case of those operating at high pressure (70 - 100 p.s.i.); (4) severe distortion of application patterns by wind for all models discharging large volumes of water from a single large nozzle; and (5) occasionally, the application rate is greater than the soil infiltration rate.

Regardless of the system chosen, it is important to remember that the system should be designed specifically for the soil and crop on which it is to be used. Designed pump capacity should not be less than 7 g.p.m. per acre, and the design for the total system should be obtained from a competent agency in order to ensure maximum efficiency.

REFERENCES:

Dept. of Agricuture, Edmonton

Tillage Machinery, Maintenance and Operation

Grass Silage for Alberta

Harvesting Malting Barley

Pub. 83—Weed Control with Chemicals

Dept. of Agriculture, Ottawa

Pub. 879—Blade Cultivator Operation and Maintenance

Pub. 999—Traction Problems with Mounted Tillage Implements

Pub. 746—Mower Repairs and Adjustments

Pub. 885—Harvesting Machinery for Hay and Silage

Pub. 881—Costs of Operating Farm Machinery

Pub.1051—Costs of Field Operations in Prairie Regions

Plow Capacity of Farm Tractors

POWER MACHINERY

Table showing relation of approximate plow capacity in terms of 14 inch bottoms and rated drawbar horsepower (from Nebraska tests) and also practical field horsepower rating.

Approx. Plow Capacity in 14" bottoms	1	2	3	4	5	6	7	8
Rated Drawbar H.P. (Neb.)	8 to 14	14 to 23	23 to 32	32 to 41	41 to 50	50 to 59	59 to 68	68 to 77
*Available H.P.	7 to 11	11 to 18	18 to 26	26 to 33	33 to 40	40 to 47	47 to 54	54 to 61

* **Available Horsepower** — Under practical field conditions the available horsepower is less than the Nebraska ratings because of the following conditions:

1. **Altitude effect:** Alberta is from 2,000 to 4,000 feet above sea level. This reduces the power output.
2. **Temperature effect:** The Nebraska ratings are based on 60°F temp. Operation at higher temperatures reduces power.
3. **Engine Condition:** Nebraska test engines are tuned up to peak performance. The average tractor in the field is at least 10 - 15% below this peak.
4. **Field and traction condition:** Nebraska tests are conducted on level track with good traction. As much as 5,000 lbs. of ballast is used. The average tractor does not have ideal operating conditions.

The available horsepower should be used to match tractor to equipment.

Table showing horsepower requirements of tillage implements in different soils

Implement	Depth inches	Speed mph	HP/ft. of width by soil type		
			light	medium	heavy
Plow-slow speed	4 - 5	3½	3	3½	4½
Plow-high speed	4 - 5	4½	4	4½	5¼
Disc plow	4 - 5	4	5½	6	6½
One-way disc	3 - 4	4	2	2½	2¾
Discer	3	4	1¼	1½	2
Blade Cultivator	3 - 4	4½	1½	2½	3½
Cultivator	3 - 4	4½	1½	2	2½
Rod Weeder	3	4	¾	1	1¼
Drag Harrow	—	4	⅜	—	½
Oscillating Harrow	—	4	⅜	—	½
Seed Drills	—	4½	¾	1	1¼

Table of Horsepower Requirements of Haying and Harvesting Machines

Balers, pick up, engine mounted	1 to 2½ HP/ton/hr.
Forage Harvester ½ inch cut	1 to 3 (PTO) HP/ton/hr.
Combine — PTO	2 to 4½ (PTO) HP/ft. of cutter bar
Combine — engine mounted	2 to 3 HP/ft. of cutter bar
Threshing Machine — 22 inch cylinder	20 belt HP
Threshing Machine — 28 inch cylinder	35 belt HP
Hammer Mill	½ to ¾ HP/bushel/hr.
Plate Grinder	⅛ to ½ HP bushel/hr.

Characteristics of Different Power Sources at Various Loads

Increase in fuel consumption per H.P. hr. at part loads, expressed as percent increase over rated load.

	Rated	¾ load	½ load	¼ load
Gasoline and Propane	0	10	33	100
Diesel	0	5	20	80

This table illustrates that the diesel is more efficient than the gas or propane engine at part loads.

Selection of Power Unit — Power plants should deliver sufficient power at the specified speed with maximum operating efficiency. Internal combustion engines and electric motors are by far the most common types of power units.

The selection of type depends on:

1. The amount of power required
2. The initial cost
3. Availability and cost of fuel or electricity
4. Annual use
5. Duration and frequency of operation

Electric motors have many advantages over internal combustion engines, such as ease of starting, low initial cost, low upkeep, wide range of operating temperature tolerance, long life and suitability for mounting on horizontal or vertical shafts. Direct drives are possible, eliminating gears and belts. Water tight vertical motors are available for deep well operation. On most farms, a limitation is placed upon the size of electric motor by the power company. The maximum size may be 5 or, in some cases 7½ H.P. For larger power requirements, internal combustion engines are required.

Diesel engines are justified when the annual hours of use are high because of the fuel savings. A propane engine will run longer between overhauls as a result of the cleaner engine operation.

A comparison of the fuel costs for tractors burning different fuels is shown in the following table:

AVERAGE FUEL CONSUMPTION WITH DIFFERENT FUELS

	Fuel Consumption — gal./hr.		
Belt HP	**Gasoline**	**Diesel**	**Propane**
10	0.72	0.55	0.97
20	1.44	1.11	1.95
30	2.16	1.66	2.92
40	2.88	2.22	3.89
50	3.60	2.77	4.87
60	4.32	3.32	5.84
70	5.04	3.88	6.81
80	5.76	4.44	7.78

To compare fuel costs for tractor operation use the current fuel prices in your area and the following procedure.

Example: Fuel costs. Edmonton area— gas — 21 cents/gal., diesel 17 cents/gal., propane 11 cents/gal.

For a 60 HP engine fuel costs are:

gasoline = 4.32 gal/hr. x 21 cents/gal. = 90.7 cents hr.

diesel = 3.32 gal./hr. x 17 cents/gal. = 56.4 cents hr.

propane = 5.84 gal./hr. x 11 cents/gal. = 64.2 cents hr.

While the fuel cost is the largest item in total operating costs the following factors must also be taken into consideration.

1. Hours of annual operation.
2. Original cost — a higher priced tractor has higher interest and depreciation costs.
3. Difference in maintenance costs — propane engines have less engine wear.
4. Fuel storage equipment — propane tanks and equipment are expensive.

For continuous operation with various power sources, best results are obtained with the following loadings:

Gas or propane water cooled —

Electric motors — Full rated capacity
Diesel engine — 80% of rated capacity
water cooled — 70% of rated capacity
air cooled — 60% of rated capacity

Traction — There are several ways of converting tractor energy into useful work. The drawbar is the most used and least efficient.

The traction capacity of a rubber tired tractor is approximately proportional to the total weight on the tires. The maximum drawbar pull is approximately one-half the weight on the driving wheels. If the tractor provides insufficient weight, liquid can be added to the rear tires, or concrete or cast iron weights can be fastened to the rims.

Tires should not be loaded beyond the manufacturer's recommendation. The liquid should be a calcium solution for frost protection. There is no significant difference in traction performance between the use of liquid, dry, or cast iron ballast. Also, there is little difference in performance between different tread designs. Tire inflation pressures should always be sufficient to prevent side wall flexing.

The rubber tire two wheel drive tractor has generally been replaced by 4 wheel drive, or by tracks, in the larger sizes. Tracks reduce ground pressure and rolling resistance in loose, soft soil surfaces. The track type tractor can exert a higher drawbar pull than the rubber tired tractor with the same total weight. Land clearing operations are best carried out with tracks or steel wheels. Crawler tractors are not widely used on sandy soils because of high track maintenance.

Remote Power Application—In addition to power being delivered and used at the drawbar, it can be transmitted to the implement by other methods. These are:

1. Belt
2. Power Take-Off
3. Hydraulic Systems
4. Electric Generator and Motor Combination.

Belt—The belt was the first method developed, but is now being replaced by the other methods.

The standard belt speed is 3,100 feet per minute, plus or minus 100 feet per minute. The belt pulley should be wide enough to accommodate a 6" belt. Belts should never be put on or pulled off while there is power in the driving pulley.

Power Take-Off — The A.S.A.E. - S.A.E. PTO standard adopted in 1923 provided for a speed of 536 plus or minus 10 r.p.m. Since then, there have been increased power demands upon PTO drives and more capacity is required. This is being accomplished by increasing the standard speed to 1,000 plus or minus 25 r.p.m.

Until such time as all tractor PTO and implement shaft speeds are the standard 1,000 r.p.m., conversion kits will be required. These may be obtained where the tractor PTO is 1,000 r.p.m. and the implement shaft 536, or when the PTO is 536 and the implement is 1,000. The manufacturer's instructions should always be followed in adjusting and operating PTO shafts.

Safety shields must always be kept in place. The new tubular shields are non-removable.

Hydraulic Systems — Hydraulic controls for farm equipment are very flexible and have a wide range of application. There are two general types of control systems:

— Limit Control
— Proportioning Control.

In limit control, the implement is raised or lowered by moving the control lever to either side of its neutral position. The piston in the power cylinder continues to move until the lever is returned to neutral or until the travel is limited by a stop. The position of the implement is adjusted by visual observation.

In proportioning control systems, the position of the lever indicates a definite depth or draft of the implement. There are two types of proportioning control systems:

In automatic position, the hand control lever indicates a definite depth of implement. In automatic draft, the hand control lever indicates a definite draft of the implement.

The oil used in an hydraulic system is very important. The manufacturer's recommendations should always be followed. Dirt is the greatest enemy of an hydraulic system. The oil should always be kept clean and the quantity maintained at the proper level.

Hydraulic motors are another means by which power can be transmitted to remote locations. One advantage of the hydraulic motor is the flexibility of the hose which can be taken to otherwise difficult locations.

Electric Generator and Motor System — An electric generator can be driven from the engine of a tractor and the power used to operate an electric motor or motors, either stationary or on a moving implement. This system provides a maximum flexibility because the electrical wires can be taken easily to any location.

A standard A.C. generator supplying 110-220 three phase power is available and this can also be used as a stand-by unit in case of regular power line failure.

FARM BUILDINGS

The open plan, low, single storey farm building, with its post-free or partition-free interior is a multi purpose, utility type structure. When used with on-ground storage of feed and bedding it facilitates mechanical handling or self feeding of these materials.

Concrete Foundations — Concrete, the usual foundation material for farm buildings, requires careful mixing, placing, and curing if it is to give satisfactory service. A footing at least 16" wide should be used for general farm structures, and wider when the building is on soft soil, or it will carry a heavy load that rests on this footing. The concrete walls will usually be 8" thick. In order to get strong concrete, clean, well graded materials should be used, and as little water as possible used to give a workable batch. Field stones larger than 1½" diameter should not be used in concrete.

Table of Concrete Mixes

Type	Uses	Proportions				Max. Stone Size
		Cement	Sand	Gravel	Water	
Waterproof	Basement walls Floors, Steps, Sidewalks, Septic Tanks, Cisterns Thick Footings,	1 sack (equals 1 cu. ft.)	2 cu. ft.	3 cu. ft.	4 gal.	1″ diam.
Permeable	Heavy Foundations, Walls(not waterproof) Engine bases	1 sack	2½ cu. ft.	4 cu. ft.	4½ gal	1½″ diam.
Thin Sections	Fence Posts, Garden Furniture Concrete about 2″ thick	1 sack	2 cu. ft.	2 cu. ft.	3¾ gal.	¾″ diam.

Note: 1. A mix of 1:2:3 is **not** the same as a 1:5 mix of combined sandgravel but will be close to a 1:3½ mix.

2. Water suggested is for **moist** sand. For wet sand the water should be decreased 1 gal. per sack. The resultant concrete should be rather sticky, and about the consistency of stiff porridge.

3. If concrete sticks to barrel of mechanical mixer, slow the machine down appreciably.

(Adaptation from Canada Cement Co. publication, "Concrete on the Farm".)

Post Pier Foundations are being used to some extent to replace concrete foundations in new structures. They are made possible by the availability of pressure treated poles, posts and sheathing. The cost is generally lower than for a concrete foundation. When used in a heated animal building the post pier foundation can be easily and economically insulated. These foundations must be set on pads of crushed rock or concrete — where the supporting posts are placed 4' apart a pad at least 12" in diameter should be under each post, while a pad approximately 21" in diameter should be placed under the poles when they are 12' apart.

Pole Frame Building — The pole frame building provides a continuous wall from below grade level to the top of the wall. This is desirable when the loading in the building results in an outward thrust near the floor, such as occurs with a manure pack. For utility buildings it is suggested that the poles be set 12' apart around the outside of the building and that roof trusses be used to give a clear span. (See "Trussed Rafter".)

Newer Framing Methods—Wall construction for service buildings has been mainly frame with 2 x 4 or 2 x 6 studding at either 16" or 24" spacing. This type of construction is being replaced to some extent by round roof arches or rigid frames that provide both wall and roof framework as a continuous member. These are generally set on 24" spacing for most economical construction.

Laminated rafters or trusses may be used for the framework of a clear span arch building or for the round or gothic roof on a conventional barn. Bent-to-round lamination is much more economical than sawn-to-round lamination.

Bent-to-Round Arches—The best quality lumber is used for the outside and inside laminations, with quality being less important as the center lamination is approached. Glue must be used on the material, which is usually 1 x 3, to weld the truss into the solid unit. Casein glue is satisfactory except where severe wetting of the truss is likely. The trusses or rafters are built up in a jig on either the floor or ground. In assembling, it is important to stagger the butt joints so that joints in adjacent plys are about 6' apart, and anywhere throughout the rafter or truss the joints are about 2' or more apart. (See "Dairy Barns For Alberta".)

Sheathing and Bracing — For wall and roof construction, horizontal 1" sheathing or siding must be strengthened by bracing. Two by four cut-in bracing has been used to a great extent, but it is definitely inferior to 1 x 4 let-in bracing. Here a continuous length of 1 x 4 is fitted into diagonal notches on the outside of the stud or truss

material. Diagonal sheathing eliminates the necessity for such bracing, but almost always requires covering for appearance. Sheathing grade plywood, either 5/16" or 3/8", offers more strength against racking than any type of bracing, and at the same time it may be used to provide the finish surface. Plywood should be applied with the face grain running perpendicular to the framework. This means that on stud walls the sheets run horizontally, and on pole frame construction they will run up and down. The horizontal joints may be of either the lap or the butt type, with the former giving the simplest construction. For waterproof butt joints on the walls, caulking compound and nailing strips must be used on the horizontal joints, but this is not necessary on the vertical joints.

Roofing—For the lowest initial roof cost, plywood may be considered, either 5/16" or 3/8" thickness being satisfactory, with the latter recommended. This will provide sheathing, weather-proofing and bracing when applied shingle fashion to rafters or trusses 24" or 16" on centre. Caulking compound and nailing strips are necessary to provide a waterproof roof. Surface protection in the form of creosote or penta stain should be provided as soon as possible after the building is completed. (See "Dairy Barns For Alberta".)

Asphalt shingles, rolled roofing, metal (either aluminum or galvanized iron), or cedar shingles may also be considered for the roof. Shingles or rolled roofing must be applied over solid decking, and bracing is advisable unless the decking is put on diagonally or plywood is used. Metal may be put on to nailing strips rather than solid decking but bracing is necessary. If hail is experienced, even occasionally, the use of aluminum should be questioned, and if used, should be over solid decking. Metal used on a curved building should be preformed to fit the curve. This will reduce the amount of nail pulling, an objectionable feature with all metal sheathing.

Floors—The floor requirements in farm service buildings vary considerably. In grain storage buildings the floor must include a moisture barrier so that soil moisture cannot move up through the flooring material. Wood floors on top of relatively heavy wooden joists have long been used for this purpose but in new construction concrete with a polyethylene moisture barrier will be more economical and just as satisfactory. In animal housing buildings, such as beef sheds, loose housing dairy barns and poultry houses using deep litter, gravel floors appear to be satisfactory. However, where the building must be cleaned regularly, such as hog barns and stanchion dairy barns, a concrete floor is recommended.

An insulative surfacing material made up of equal volumes of cement and vermiculite, mixed to a stiff consistency and applied 2" thick over standard concrete, appears to improve the comfort conditions of a concrete floor. This material will stand up to the wear imposed by either cattle or hogs. (See "Vermiculite Insulated Concrete".)

Heating and Ventilation—Animal buildings, where controlled conditions are required, present additional problems and the most critical of these is moisture removal. This is the main function of the ventilating system. This in turn depends on the heat supply, which is related to the number of animals in the building, the insulation, the inside temperature required and whether or not supplemental heat is available. Insulation equivalent to 2" of mineral batt type materials or 4" of shavings or straw, is considered to be the minimum requirement for wall insulation in this climate. Ceiling insulation should be 1½ times that of the wall.

Because moisture problems are severe in all except loose housing type animal buildings, both the insulation and framing material should be protected by a vapor barrier. It is suggested that polyethylene be used for this purpose and should be provided in addition to the vapor barrier that is already on the batt material if such is being used. The vapor barrier is placed as close as possible to the warm surface, which means in most construction directly under the inside sheathing. It is just as important on the ceiling as on the walls. A vapor barrier is never used on the cold side of the wall.

After precautions have been taken to save as much heat as possible and to control the moisture so that it cannot destroy the building materials, it is possible to proceed with ventilation. In any system of ventilation, warm, moist air is exhausted from the building and replaced by cold, relatively dry air from outside. In simpler types, the warm, moist air is collected by a flue or fan and discharged directly from the building, while an attempt is made to introduce the cold air in a thin ribbon around the upper perimeter of the building. This is done in order to prevent cold drafts. A flue system will tend to overventilate during moderately warm weather, and automatic control is relatively difficult to obtain. A simple fan system, providing the fan is left running continuously during the ventilation season, will ventilate at a steady rate, which is superior to the performance of the natural draft system. Even this can be improved by regulating the amount of air that the fan picks up, either by the use of a two-speed fan or by the use of a motorized damper and thermostat. These controls should reduce the warm air

output to about one-half during cold weather. (See "Barn Ventilation", and "Ventilation of Dairy, Poultry and Pig Buildings".)

In most hog and poultry buildings, supplemental heat will be required during extremely cold weather. This can be most economically provided by a heater which only warms and circulates the air in the building. A ventilation system will introduce and expel the necessary amount of air either for humidity or temperature control. Usually no attempt should be made to combine the separate functions of heating and ventilating into one unit.

Building Maintenance—Frame constructed farm service buildings represent an appreciable investment and their life can be extended appreciably by the periodic use of paint or other protective coatings, and this should be considered as essential a part of the construction as good foundations or weatherproof design.

REFERENCES:

Dept. of Agriculture, Edmonton

Concrete on the Farm

Pub. 7—Dairy Barns for Alberta

Plan 547—Barn Ventilation

Plan 550—Trussed Rafter

Plan 556—Vermiculite Insulated Concrete Rigid Frames

Dept. of Agriculture, Ottawa

Pub. 1129—Ventilation of Dairy, Poultry and Pig Buildings

ELECTRICAL POWER

Electric power on the farm is expanding rapidly and is generally available on the farm as 115/230 volt single phase A.C. It is an economical and flexible source of power that can be utilized for lighting, motive power, and heating. Electric power is very adaptable to automatic and semi-automatic installations that will reduce labor requirements on the farm.

A permit, obtainable from Electrical Protection Branch, Department of Labour, is required for a new installation or additions to existing wiring. Where an electrician is employed he will obtain the permit, while if he is doing the work himself the farmer must obtain the permit. In the case of a new service connection, the permit is the authority for the power company to supply the installation.

Planning the System—Before a building is wired it is desirable to plan the wiring carefully in order that the service entrance and wiring are adequate to handle future requirements. This planning will eliminate costly re-wiring of a building at a future date.

The farmstead may be wired with the conventional overhead system. However, underground wiring presents advantages, and the installation costs are approximately the same. In planning the wiring system, consideration should be given to connecting the water pump so that it will be operative for fire fighting, even after power has been cut off at the buildings.

Protective Equipment—The circuit breakers in the service entrance panel will provide overcurrent protection. However, an electric motor requires overload protection. Without the overload protective unit is is possible to burn out the motor even though there is not sufficient current to trip the circuit breakers. Some electric motors are equipped with an overload protection unit built into the frame of the motor, whereas others require the overload protection unit to be wired into the supply line circuit.

Grounded NEMA outlets provide protection against electrical shock from faulty electrical equipment. NEMA grounded outlets are required in all farm installations. All electrical equipment that does not plug into an outlet, but is wired permanently, must also be grounded. Grounding of electrical equipment, such as electrical watering bowls, is particularly important to protect livestock.

When purchasing any electrical equipment for the home or farm, make certain that it has the C.S.A. (Canadian Standards Association) approval on it.

Heat Lamps—The proper installation of heat lamps will eliminate a fire hazard and breakages that so often accompany a haphazard installation. The correct lamp receptacle should be used and the unit must be suspended by a chain and not by the cord. Farm Wiring Regulations outline additional requirements for a heat lamp installation.

When selecting an electric motor, the speed of the driven machine should be considered, as electric motors are generally available in speeds of 1,140, 1,725 and 3,450 r.p.m. The electrical motor has a number of advantages over the gasoline engine. (See section on "Farm Power".) The electric motor will operate continuously under full rated load, while the internal combustion engine can only operate at 60% to 80% of the rated capacity. For this reason, the size of an electric motor required can be ½ to 2/3 that of the gasoline engine it replaces. Electric-motor driven machines that are difficult to start will require a capacitor or a repulsion-induction motor.

Starting Characteristics of Single Phase Electric Motors

Type of Motor	Starting Torque	Maximum Starting Current
Split Phase	Low, 1-2 times running torque	High, 5-7 times running current
Capacitator	Medium, 2-4 times running torque	Medium, 3-4 times running current
Repulsion Induction	High, 3-5 times running torque	Low, less than 3 times running current

See References

FARM UTILITIES

Water Supply—The well is the most common source of a farm water supply and generally is free of disease producing bacteria. In some cases well water may contain salts that impair the quality; however, in most cases they can be removed. If a well is contaminated it is generally by surface water entering the well, and this can be prevented by sealing off the top against infiltration. Surface drainage should be provided away from the well. Springs are a form of well, and generally provide a good source of water.

Dugouts, streams, lakes and ponds will generally provide an adequate supply of water. However, if used for domestic purposes they must be filtered and treated.

Water Systems—The type and size of the pumping unit will depend on the capacity of the well, volume of water to be used and the depth of well. A jet pump has the advantage that it need not be located directly over the well. However, it is not desirable for use on a low capacity well, or a well where the lift exceeds 100'. The reciprocating pump, and particularly the balanced beam type of pump, is recommended for low capacity wells and can be used for any depth required. The submersible pump is generally used as a deep well, high capacity pump.

Piping — Any yard piping should be placed at a minimum depth of 8' underground to prevent freezing. Three-quarter inch pipe should be the minimum size for yard piping, and in many cases a larger size may be necessary to ensure an adequate flow of water, particularly where water is moved long distances. (See Table I, page **154,** Polyethylene pipe is easy to install and low in cost. Galvanized pipe and copper pipe are more difficult to install in trenches and the cost is higher. Ice in metal pipe may be thawed by an electric welder. Copper or galvanized pipe should be used for inside plumbing and plastic must not be used for this purpose, according to present regulations.

Sewage Disposal — Safe sewage disposal on the farm is an important health consideration. The septic tank system has been proved the most satisfactory. The septic tank should be a two-compartment type with a syphon or pump chamber to prevent freezing of the sewer line.

Corrosion generally limits the life of a steel tank from 7 to 10 years, therefore a more permanent type of septic tank, such as concrete, is recommended. Also newer types of prefabricated fibre glass septic tanks may be satisfactory, however, their use has not been extended over a long enough period to provide definite information as to the life of the tank.

There are several methods of disposing of the effluent, such as the use of a field, leaching cesspool, above ground filter, sand filter, pumpout cesspool, and the surface evaporation pad. The system to use will depend to a great extent on the conditions around the farmstead, such as the porosity of the soil, slope, proximity to wells, etc.

Heating—Alberta farmers have a choice of fuel. Natural gas is the cheapest, and, where available, will normally be used. Where natural gas is not available there is a choice of coal, oil, propane and electricity. The cost of eletcricity makes it prohibitive for heating the home or farm buildings. However, there are applications, such as heat lamps, radiant heaters and water heating, where it may be used to advantage. Coal, oil or propane may be used for heating the home or other buildings. An automatic coal stoker furnace will normally cost more to install than oil or propane, the fuel costs will be low, but the fuel is not as clean to use as oil or propane

(See Table next page.)

The following table will give the comparative costs of each fuel at various prices:

Fuel Comparison Table

Fuel	Price	Heat Content	Efficiency	Useful Heat for each cent
Natural Gas	33-1/3c/M cu. ft.	957 BTU/cu. ft.	75%	21,500 BTU
	50c/M cu. ft.			14,300 BTU
	80c/M cu. ft.			8,960 BTU
Coal (Tofield)	$8.00/ton	8,000 BTU/lb.	50%	10,000 BTU
	$6.00/ton	8,000 BTU/lb.	50%	13,300 BTU
(Drumheller)	$16.00/ton	10,00 BTU,lb.	50%	6,250 BTU
Oil	12c per gal.	168,000 BTU/gal.	75% (gun)	10,500 BTU
	20c per gal.	168,000 BTU/gal.	75% (gun)	6,300 BTU
	15c per gal.	168,000 BTU/gal.	75% (gun)	8,440 BTU
			65% (gravity)	7,380 BTU
Propane	11c per gal.	109,000 BTU/gal.	75%	7,420 BTU
	12c per gal.	109,000 BTU/gal.	75%	6,810 BTU
	15c per gal.	109,000 BTU/gal.	75%	5,440 BTU
	18c per gal.	109,000 BTU/gal.	75%	4,540 BTU
	20c per gal.	109,000 BTU/gal.	75%	4,080 BTU
	25c per gal.	109,000 BTU/gal.	75%	3,270 BTU
	30c per gal.	109,000 BTU/gal.	75%	2,720 BTU
Electricity	2c per kwh	3,412 BTU/kwh	100%	1,706 BTU
	1½c per kwh	3,412 BTU/kwh	100%	2,559 BTU

The efficiency of the heating unit has been considered for each fuel so these costs are comparative.

e.g.—Compare coal at $8.00 per ton with propane at 15c per gallon: From the table:

Under the column "Useful Heat for Each Cent" coal at $8.00 per ton will provide 10,000 BTU's for one cent, and propane at 15c per gallon will give 5,440 BTU's for one cent. At the above mentioned prices propane provides approximately one half as much heat for one cent, or in other words, the cost of heating with propane is twice that of coal in this case.

Electricity — Rural electrification is one utility that has eased the chores on the farm considerably, and since this subject has been dealt with nothing further will be considered.

REFERENCES:

Dept. of Agriculture, Edmonton
Farm Water Systems and Sewerage Treatment of Farm Water Supplies
Pub. 36—Cost Comparison for Water Heaters
Dept. of Health, Edmonton
Private Sewage Disposal
Dept. of Labor, Edmonton
Regulations Governing Interior and Farm Wiring

MATERIALS HANDLING

Materials handling is any operation which changes the location of a material, the moving of things from one place to another.

Development is directed towards eliminating those restrictions on the size of a farm enterprise, which are determined by how much the farmer can move, carry or distribute in his working hours. Every phase should be regarded as a link in a sequence of operations including transportation and storage, with clear recognition that any step can slow the whole operation.

Materials handling is often inefficient, because of outmoded methods such as fork and shovel operations. As an example of the discrepancy between field and farmstead mechanization, silage handling in the field is done by forage harvesters while only 4% of the silage is removed mechanically from the silos. This example points to the need for considering the overall process, rather than single operations.

Handling Granular Materials

Elevating Equipment — The free-flowing characteristic of small grains and pellets permits both vertical and horizontal movement. Some devices, such as the screw or auger, can be used at any elevating angle. Others are best suited for vertical or horizontal operation only. Still other devices such as the chain and flight conveyor, are practical at angles from horizontal to a maximum of about 45 degrees.

Centrifugal-Discharge Bucket Elevator— The bucket elevator is the most efficient means of producing vertical movement of free-flowing materials, and the centrifugal-

discharge elevator is the most common type. In this type of elevator, buckets are uniformly spaced on a belt or chain to prevent interference when discharging. Material is discharged by centrifugal force at the head. It is picked up by direct loading into the buckets and by scooping from the boot at the foot of the elevator. Figure 1 shows the relationship between the head wheel speed and the radius of the path of the centre of gravity of the material in the bucket for satisfactory discharge at high and moderate elevator speeds.

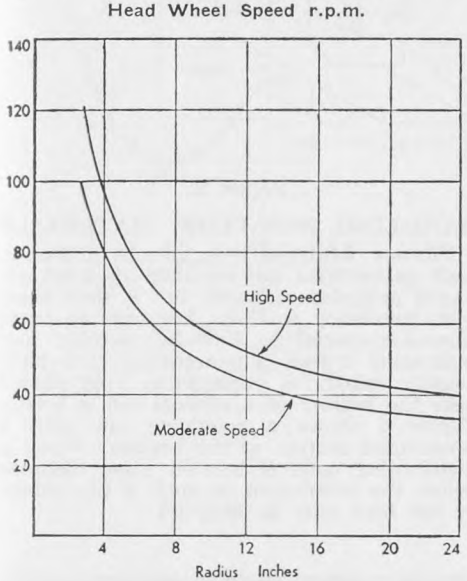


Figure 1.

The speeds and diameters of head wheels for high-speed centrifugal discharge elevators are not satisfactory for handling light dusty materials such as ground feeds. The wheel speeds may be reduced by 80 percent as shown by the moderate speed curve in Fig. 1. This reduction in speed will reduce the dust problem and provide better pickup.

Elevator Capacity — The capacity of a bucket is considered to be from 85 to 90 percent of the struck volume for high speed, if the feed is arranged to allow loading at or above the center of the foot shaft. If loading is below this point, the capacity may be reduced to 80 percent of the struck volume. On moderate speed elevators, the bucket should be expected to fill 90 percent of its struck volume.

Elevator capacity may be calculated as follows: Elevator Capacity (lb. per min.) = Bucket Capacity (lb.) x Belt speed (fpm) / Bucket Spacing (ft.)

Elevator Horsepower—In practice, theoretical horsepower required to lift the material needs to be increased only 10 to 15 percent to obtain the actual power requirement. Theoretical horsepower may be calculated as follows: Horsepower = Elevator Capacity (lb per min) x Height (ft) / 33,000 ft. - lb. per min.

It is advisable, in determining horsepower, to use the struck volume of each bucket in determining the elevator capacity. This will eliminate power failures where feed rate is high and the buckets are filling well above the center of the foot wheel.

The auger or screw conveyor, in which the auger is contained within a cylindrical tube, has been used extensively for both conveying and elevating free - flowing materials. Some general conclusions regarding auger conveyors follow:

Maximum capacities occur between 700 and 900 r.p.m. for 6" diameter augers and at speeds over 1,000 r.p.m. for 4" augers.

The capacity in a vertical position is from one-third to two-fifths the capacity in the horizontal position.

Horsepower requirement increases directly with speed from 300 to 1,000 r.p.m. and varies with the type of material elevated.

Maximum horsepower is required at elevating angles of 50 to 60 degrees. Maximum elevating efficiency also occurs at these angles.

Auger length has no effect on auger capacity nor on the horsepower required per foot of length.

Gravity Flow of Granular Materials — Granular materials, such as small grains and pellets, are generally considered to be free-flowing. However, in the presence of dust, cracked material and excessive moisture, such material may show a reluctance to flow. Reluctance of some granular materials to flow increases the difficulty of designing handling systems. This problem can be eased by application of some of the following principles.

Compaction caused by combination of bin pressures, impact on filling and vibration is generally responsible for arching or bridging at the discharge point. This compaction may be reduced in a number of ways. Bin pressure in the main portion of the bin may be reduced by installing a criss-cross partition, i.e. two partitions at right angles to each other at the center of the bin. Another method of reducing bin pressures is to use continuous ledges around the side walls at vertical intervals. Shelves hung at intervals in the center of the bin have the same effect.

When a hopper is used at the bottom of the bin, bridging may occur. The Board of Coal Research has successfully overcome this problem in bins for granulated coal by incorporating the device shown in

figure 2. A large top opening, which encourages flow, is reduced to a small opening suitable for delivery by passing the material over a cone.

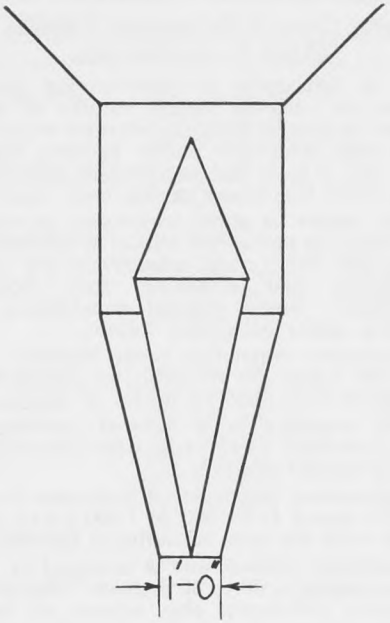


Figure 2

Metering Devices — Meters are used to regulate flow. e.g. when it is desired to grind two or more grains in fixed proportions. The flow of each grain to the grinder can be regulated by a meter. Three types of meters are in general use for continuous measurement as against batch measuring. The first is the belt meter which covers the floor of a storage bin and is suitable for even non-free-flow material. When the material to be metered flows more freely, auger meters and vibrator meters can be used. The auger meter is simply an auger in which the capacity is regulated by varying the auger speed.

The vibrator meter consists of a box with a trough on one side that extends out several inches and an electrical vibrator attached to the bottom of the trough. The trough of the vibrator is sloped a few degrees below the horizontal and this imparts a forward movement to the material as the meter is vibrated. The usual method of regulating capacity is to control either the gate opening into the trough or the vibrator voltage. Quite often the gate is used for approximate setting, while the voltage is controlled for close adjustment. Fig. 3 shows a vibrator meter.

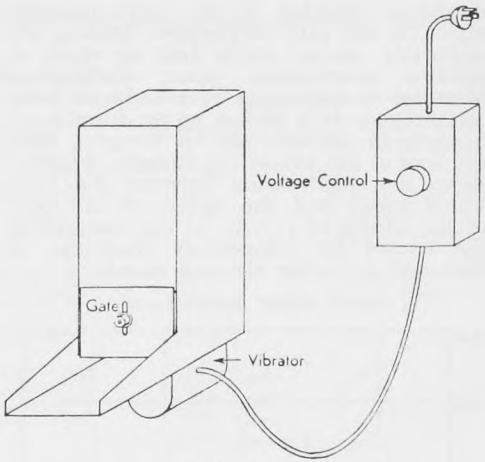


Figure 3.

HANDLING NON-FLOW MATERIALS

Fibrous Material — A fibrous material, such as chopped hay or silage, is most unlike a granular material, but it does show some tendency to flow. Attempts to cause fibrous material to flow by piercing and separating it with a penetrating cone have usually failed. A constricting ring placed near the bottom of a vertical bin is better. Figure 4 shows a roughage bin with a constricted section at the bottom. When a distributing cone is located some distance below the restriction in such a bin, silage or cut feed may be self fed.

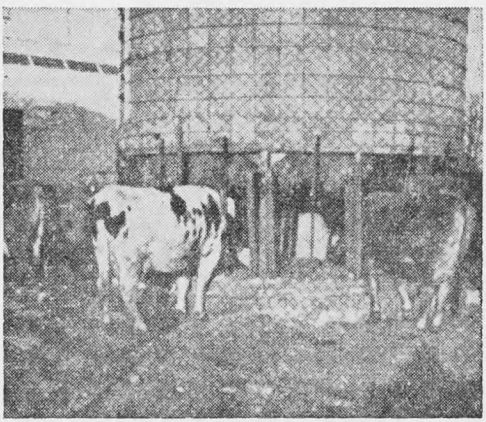


Figure 4.

Self-feeding upright. Experimental self-feeding upright silos have been perfected at Michigan State College (above) and Rutgers University. Secret is to support the mass in silo. Some handwork is needed to adjust supports which regulate silage flow.

Proper filling of bins is important. Applying the cut material around the perimeter of the bin is very desirable if self-emptying is to be attempted later. Figure 5 illustrates this method of filling.

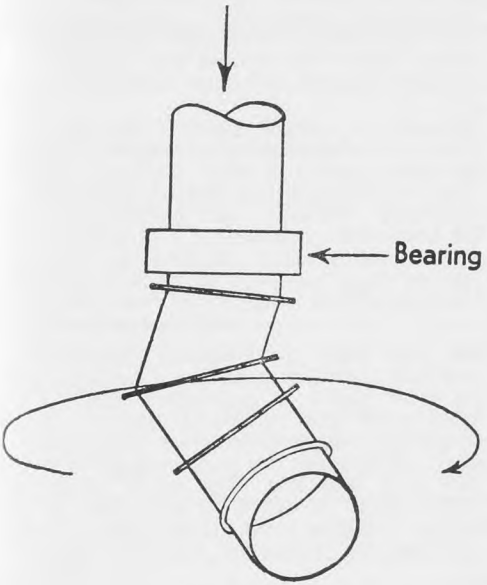


Figure 5.

Unit Loads and Stacks — The fork lift truck has had a great impact on industrial materials handling. In the past, batches of material were sized so that a man could lift and move them. The advent of the fork lift has resulted in increasing the size of the batches or unit loads to a practical size for the fork lifts. Common sizes are 4' x 4' pallets for materials which can be stacked and 20 bushel bins for bulk materials.

Fork-lift trucks, combined with 20 bushel bins, are being used extensively in apple harvesting and processing. Pickers empty their buckets into the bins. The bins are carried by fork-lifts to flatbed trailers. Orchard fork-lifts usually consist of both front and rear fork-lift units mounted on an agricultural tractor. Removal of the bins from the trailer at the processing plant is also by fork-lift. The possibility of a similar principal being used to handle baled hay is suggested. If bales were tied or otherwise handled in units of 9 or 12, an economic unit load for mechanical handling would be available.

The word "stack" as used in farming generally refers to a bulk of material piled outdoors and so large that it cannot be moved in one load. In the case of hay, the recently introduced stack mover has altered this concept. The combination of sweep stackers for stacking, stack mover for transport and grapple fork, or self feeding, for removing hay from the stack presents an economical method of handling and feeding forage under some conditions.

Roughage Conveyors—The farmer should remember the cardinal principle of materials handling: **"Don't handle it if you don't have to."** Self feeding should be employed wherever possible. Where conveying becomes necessary, as in stanchion barns, the auger conveyor, chain and paddle conveyor and the 45 degree manger conveyor are available. Forage and silage feeders, employing each of the above principles, together with provision for metering concentrate and minerals into the conveyor to be fed with the roughage, are available from commercial firms, or have been assembled by farmers. It is estimated that 75% employ auger type conveyors.

HANDLING LIQUID MATERIALS

The two considerations involved are transporting and metering. In some installations, as sprinkler irrigation, both problems occur simultaneously.

Liquid Transport — Liquids are usually moved through pipes. Flow occurs when a pressure or "head" is applied to the liquid by means of a pump or by a difference in elevation. The rate of flow is determined by the head and by the resistance or friction offered by the pipe size, so if the pipe size is too small, a very high pressure is required to obtain a desired flow. Table I shows friction head in pipes carrying water.

The power to overcome this friction is usually supplied by a pump. The theoretical power required to pump liquid through a pipe can be calculated as follows: H.P.=

$$\frac{\text{lb. Liquid Pumped/min. x Total Head in ft.}}{33{,}000}$$

where the total head may be made up from:

(1) difference in elevation between the inlet level and the discharge point.

(2) friction head (see Table I).

(3) head required at the discharge end. For free discharge, head at discharge end is nearly zero, while for a sprinkler for instance, head required at the inlet to the sprinkler may be 100 feet or more (1 psi=2.31 feet of head).

Actual horsepower may be from 20 percent to more than 100 percent higher than the theoretical horsepower, depending upon the efficiency of the pump and drive.

TABLE I

Frictional Resistance to Flow of Water

FRICTIONAL RESISTANCE IN FEET OF HEAD PER 100 FEET OF PIPE

Rate of flow Imp. gallons per minute	Sizes of pipe in inches							
	½"	¾"	1"	1¼"	1½"	2"	2½"	3"
1	5.2	0.7	0.2					
2	18.6	2.5	0.6	0.2				
3		8.8	2.1	0.7	0.3			
4		13.3	3.1	1.0	0.4	0.1		
5		18.6	4.4	1.5	0.6	0.2		
8			11.2	3.8	1.5	0.4		
10			15.6	5.3	2.2	0.5		
15			33.0	11.3	4.6	1.2	0.4	
20				20.6	8.4	2.1	0.7	0.3
25				29.0	11.7	2.9	1.0	0.4
30				38.5	15.5	3.9	1.3	0.5
35					21.0	5.5	1.9	0.8
40					30.0	7.5	2.5	1.0
65						15.8	5.3	2.2
85						27.0	8.9	3.7

Note: The friction in a 90° elbow is approximately equal to the friction in 10 ft. of straight pipe.
This table is for galvanized iron pipe. Smoother pipes have lower values of frictional resistance.

Pump Types—The selection of a pump should be based on the head required together with other factors such as the properties of the liquid to be pumped. Factors such as abrasive and corrosive properties and liquid viscosity are most important in selecting a pump for a particular job.

Centrifugal Pump is widely used for pumping water, milk, lubricants and chemical solutions. It is relatively simple, has high mechanical efficiency under favorable conditions, and can handle fluids containing solids in suspension. Disadvantages are that it is not self-priming, unless specially equipped, and high pressures cannot be obtained with single stage pumps. The centrifugal pump is used almost universally for sprinkler irrigation.

Gear Pumps are positive displacement units and are quite inexpensive and simply constructed. The chief disadvantage is that abrasive particles which may be present

in the liquid quickly destroy the close tolerances that are necessary for the pumps to develop normal pressures. Gear pumps are not suitable for pumping wettable powders.

Vane Pumps have similar characteristics and limitations to gear types. Recently, metal vanes have been replaced by nylon rollers or vanes. This change has greatly increased the resistance to abrasion. For this reason, vane pumps with nylon rollers are now widely used for sprayer application.

Piston and Plunger Pumps are usually employed where pressure higher than that readily obtained with a rotary pump is desired. The barrels and plungers are subject to scoring by abrasive particles. Adaptability has been greatly increased by the use of ceramic barrels and nylon plungers. Pumps so equipped may be satisfactorily used for pumping liquids containing abrasive particles.

Diaphragm Pumps have been used for many years for pumping materials containing a large proportion of solids, such as liquid manure. Recently they have been designed with metal diaphragms making it possible to use them at moderately high pressures. Tests have indicated that the life of this type of pump is many times that of rotary pumps when used for pumping such abrasive materials as wettable powders.

Helical Screw Pumps have shown that they are quite suitable for pumping manure, even in a semi-solid state. Liquid manure has also been successfully pumped from storage sumps into tank wagons by ordinary grain augers.

Corrosion — For chemicals, use pumps that are constructed from materials that do not corrode with the particular chemical. Chemical suppliers should be able to furnish information on suitable pump materials for their chemicals.

Liquid Metering — Liquid handling, such as application of liquid fertilizers and soil funigants, or molasses feeding or crop spraying, require liquid application at a controlled rate.

Liquid may be metered through a positive displacement pump, either of the piston or rotary type. For each piston stroke or revolution of the rotor, a definite quantity of liquid will be delivered. Delivery rate varies with the number of piston strokes per minute or of the revolutions per minute of rotary types. With piston pumps, the application rate can also be altered in some instances by changing the pump stroke. This metering principle is used extensively on field applicators, with the pump driven directly from the ground wheel.

The rate of flow of a particular liquid through an opening or orifice is determined by the size of the opening and the pressure, or head, applied to the liquid, according to the following relationship:

$$\text{Flow} = K A \sqrt{P}$$

Where K = a constant, determined by the properties of the liquid and the orifice.
A = the area of the orifice.
P = the pressure applied.

It can be seen from this equation that the flow for a particular liquid varies directly as the area of the opening and as the square root of the pressure applied. Doubling the area of the opening doubles the flow, while doubling the pressure increases the flow by only 41%.

The principle of an orifice is widely used in liquid metering. The pressure is often the most convenient variable so that metering is controlled by varying the pressure. Methods of varying the pressure include the changing elevation of the liquid container in a gravity system, pressurizing the liquid by means of a pump equipped with a pressure limiting valve, and pressurizing the liquid tank by means of an air compressor. All of these principles are readily adapted to the metering of liquids commonly used in farming.

Where viscosity changes appreciably with temperature as with molasses or lubricating oil, the rate of flow also changes with temperature. When these are to be metered through an orifice, some temperature readily reproducible, such as room temperature, should be selected.

REFERENCES:

Because principles of materials handling are relatively new to Agriculture, there are few bulletins. A list of textbooks dealing with this subject has been compiled and copies of the list are available on request from:

The Department of Agricultural Engineering, University of Alberta, Edmonton.

Extension Engineer, Department of Agriculture, Edmonton.

Agricultural Economics

Economics is an inherent part of agriculture. Each time a decision is made by a farmer or rancher he must use economics. These decisions include a variety of items in the every day life of agriculture. Decisions on buying, selling, feeding, breeding, seeding, etc., all encompass economics in the agricultural setting. Hence, the field of agricultural economics includes sections which deal with principles vital to the successful operation of the farm or ranch as a real business operation. In the material which follows, the two major areas of Farm Management and Marketing are discussed first and a third area on business arrangements, credit, etc., concludes the section on Agricultural Economics.

FARM MANAGEMENT

The science of management is difficult to define. Yet the ability to manage must be important, because some individuals become successful in their businesses, while others, with similar resources do poorly, or fail completely. Some do not take the time, or lack the ability and patience to weigh alternative courses of action, from the view of risk, profit, opportunity, and feasibility.

Farm management deals with the organization and operation of a farm with a view to the greatest continuous profit. It places the operation of a farm on a business basis, producing at the lowest cost and selling to best advantage.

Farm management deals with the processes of making sound decisions, using proven economic laws and principles.

Sound decision making involves the following steps all of which are necessary:

1. Recognizing the basic problem.
2. Looking for the alternative solution.
3. Analyzing to select the best solution.
4. Taking action on the selected alternative.
5. Bearing the responsibility of the outcome.

This section deals with some of the tools of sound business, management, namely:

1. Farm Records
2. Farm Business Analysis
3. Budgeting

FARM RECORDS

Farm records are not an end in themselves. They are however, an indispensible link in the chain of business practices leading toward better planning, and more effective use of farm resources.

A recording system will give a simple but accurate "figure picture" of the farm business, in dollars and cents, and should include such information as crop and livestock yields, feed, and other physical records. Facts concerning past performance lead to better decisions for the future.

The principle purposes of farm records are:

1. **To give a history of performance of the farm.** A complete record over the years shows the operator whether or not he is increasing the financial status of his business. An increasing yearly net worth statement shows that his assets have outgrown his liabilities. A declining net worth statement is a warning for him to stop and seriously examine his operations. A well prepared operating (profit and loss) statement will help him analyze happenings between annual "net worth" calculations.

2. **To aid in the control of current** operations. Current farm records tell how the business is conforming to plans or budgets set up for it. In many businesses outside of agriculture, monthly analyses keep a constant check of the operations. Even the busy farmer should insist on periodic checks of his business. Prompt detection of weak points may prevent serious losses.

3. **To provide basic information for future production plans.** Farmers, like other business men, need reliable and practical information in making plans for next month, next year, or even five years from now. They need it for small adjustments, or for major changes. Records give needed information on cost and price relationships, crop yields, rates of gain, butterfat production, etc. Such data are necessary for accurate budgeting, since estimates may be quite inaccurate.

4. **To provide detailed information for income tax filing.** Without records small items of expense are forgotten and these can add up to a considerable sum over the year. A systematic farm account makes the task of filing income tax returns much easier. The tin can, or shoebox file requires a great deal of sorting at the end of the year, and chances are that bills were not received to cover all of the year's transactions. Discrepancies usually lead toward overestimation of taxable income.

There are two basic financial statements which every farmer would find it worth while to prepare: (1) net worth statement (2) operating statement which requires (a) a cash account (b) record of new debts and of payments on old debts (c) a financial summary. Note: the forms for each of these accounts are usually included in good farm accounts books or may be obtained from the Alberta Department of Agriculture, Edmonton. See your District Agriculturist.

A Net Worth Statement or Balance Sheet is a statement of the balance between the farm operators assets (what he owns) and his liabilities (what he owes against his assets) at a particular point of time, usually at the end of the calendar year. It gives an appraisal of the operators equity in the business. If it includes personal assets and liabilities, it will indicate his net worth. The formula used is — Total assets equals lia-

bilities plus operators net worth. The net worth or balance sheet is a "snapshot" of the operators business affairs at a particular point of time. This is the type of statement bankers demand when a loan is requested. Net worth statements tell the farm operator three basic things:

1. The kind and amount of his assets and liabilities.
2. The amount of equity he has in the business.
3. The increase or decrease in his equity from one net worth statement to the next.

(Form 1) **FARM OPERATOR'S NET WORTH STATEMENT (1)**

Item	Value	
	Beginning of Year	End of Year
Farm Assets:—		
Land and Buildings		
Sub Total		
Farm Machinery		
Sub Total		
Livestock		
Sub Total		
Supplies and Produce		
Sub Total		
Total Farm Inventory		
Farm Accounts Rec.		
Sub Total		
TOTAL FARM ASSETS		
Personal Assets:—		
Household effects		
Cash on hand		
Personal Accounts Rec.		
Other Personal Assets:—		
Bonds		
Other property		
TOTAL PERSONAL ASSETS		
TOTAL ASSETS		

(Form 2) **FARM OPERATOR'S NET WORTH STATEMENT (2)**

Item	Value	
	Beginning of Year	End of Year
Farm Liabilities:—		
Land		
Machinery		
Other farm debt		
Interest on farm debt		
Total Farm Liabilities		
Personal Liabilities:—		
Groceries		
Furniture		
Doctors		
Total Personal Liabilities		
TOTAL LIABILITIES		
Total Farm Assets		
Less: Total Farm Liabilities		
Equals: Farm Net Worth		
Total Assets		
Less: Total Liabilities		
Equals: OPERATOR'S NET WORTH		
CHANGE IN NET WORTH (end of year minus beginning of year)		

Operating or Profit and Loss Statement: While a net worth statement tells the operator where he stands on a certain day, the operating statement explains how he got there. It fills in the gaps between net worth statements, and measures his efficiency. If the net worth statement is a still snapshot, the Operating Statement is a moving picture type of summary. The accumulation of information required to prepare an operating statement constitutes what most farm operators consider as bookkeeping. The majority pay their income tax as assessed from a "cash operating statement," but a few may elect to file on the accrual basis, a rise in inventories being added to income, while a drop is considered an expense. The accrual method gives a truer picture of farm operating expenses (input) and farm operating receipts (output). Thus the acrual or inventory method is most satisfactory for farm management work, regardless of which system is used for income tax filing.

Two Necessary Steps

Steps in farm accounting to accumulate information for a true operating statement are:

STEP (1) At the beginning of the accounting period, usually January 1st, list the inventories of farm assets showing type of asset, and the appraised present market value. The present market value as deter-

mined at the time of inventory is often a more realistic value to the owner than using an artificial depreciation percentage rate, or income tax rates which often do not reflect the true present market value to the owner.

Below is shown a simplified example dealing with opening, and closing inventories.

STEP (2) List the farm business expenses and receipts as they occur throughout the year. One should differentiate between Capital expenses which are assets lasting for several years, e.g. buildings, machinery, and in certain cases tires or tools, and operating expenses, i.e. items which are used up within the accounting year, such as seed, gas, oil, and repairs (unless they are major repairs which add substantially to the value of the implement). There is no fixed line between the two types of expenses, but they affect the Profit and Loss appraisal differently. Similarly it is necessary to separate capital sales of equipment or real estate from operating receipts of farm production such as crops or livestock.

(Form 3)

CASH FARM EXPENSES

Date	Number or Amount	Description of Item	Total Value
TOTAL CASH EXPENSES			

(Form 4)

CASH FARM RECEIPTS

Date	Number or Amount	Description of Item	Total Value
TOTAL CASH RECEIPTS			

Column headings are flexible and should be set up to be of most use to the farmer concerned.

STEP (3) At the end of the year, close the transactions with a closing inventory (beside the opening inventory for ease of compilation and comparison). See Forms 1 and 2 — "Operators Net Worth Statement."

STEP (4) Summarize the year's business and prepare an operating or Profit and Loss statement to find net income, labor

(Form 5)

PROFIT and LOSS STATEMENT and CHANGE IN OPERATOR'S NET WORTH

To Get Net Farm Income:—

Total Cash Farm Receipts	.....
Less: Total Cash Farm Expense	.....
Equals: Cash Farm Income	.....
Plus: Farm Inventory Increase	.....
Less: Farm Inventory Decrease	.....
Plus: Increase in Farm Accounts Rec.	.....
Less: Decrease in Farm Accounts Rec.	.....
Plus: Reduction in Farm Debt	.....
Less: Increase in Farm Debt	.....
EQUALS NET FARM INCOME	_____

To Get Change in Operator's Net Worth:—

Plus: Personal Cash Receipts	.....
Less: Personal Cash Expense	.....
Plus: Increase in Personal Inventory	.....
Less: Decrease in Personal Inventory	.....
Plus: Reduction in Personal Debt	.....
Less: Increase in Personal Debt	.....
Plus: Increase in Personal Accounts Rec.	.....
Less: Decrease in Personal Accounts Rec.	.....
EQUALS CHANGE IN OPERATOR'S NET WORTH	_____

Note: The final figure for change in Operator's Net Worth should be equal to change in Operator's Net Worth as calculated in Form 1 or books do not balance.

earnings to the operator, and return on farm investment. This is also the logical time to prepare a new Net Worth Statement.

Form 5 represents one basic operating statement, but there are several forms available. Many operators prefer to show depreciation as a separate expense, instead of having it absorbed in inventory change and purchases and sales of capital equipment, as is the case in the form shown here. This can be done without changing the final profit answer, by omitting sales, purchases and inventory change of buildings and equipment, and instead, adding as an expense the amount of depreciation taken for the year.

The foregoing steps comprise the basic requirements for preparing the two main finanical statements, namely the Net Worth or Balance Sheet, and the Operating or Profit and Loss statement. These, together with physical records on crop and livestock yields, feed and labour usage, provide information for analysis of the farm business, and for budgeting and income tax.

This brief survey of farm bookkeeping principles is intended to indicate both the nature of the basic farm accounts and the effort required to prepare them and also the usefulness of these accounts to the farmer in conducting his business. In the recognition of the importance of farm accounts on modern farms with high investment and a large turnover of money, the Extension Department of the University of Alberta has prepared a correspondence course in farm bookkeeping which covers the whole subject in a thorough but understandable way. Enquire to the Agricultural Secretary at the Extension Department, University of Alberta, Edmonton.

ANALYSIS OF MANAGEMENT FACTORS

Analysis of the year's business is the next step in the farm management process. Farm records are a guide during the year in making management decisions, and annual analyses at year-end disclose weak and strong spots, as they relate to profit.

Some factors affecting earnings are very important, others are less significant. Some are beyond control of an individual farmer while others can be regulated through sound business management. A successful farm is one that pays all expenses and yields the farm family a good living over a long period of time.

Farm Receipts

Generally speaking, farm receipts should be sufficient to:

a. pay all cash operating expenses;

b. provide for depreciation of equipment;

c. take care of land conservation necessary to maintain incomes over a long period of time.

d. provide a fair interest return on farmer's farm investment.

e. provide a wage for farm work done by farmer's family.

f. leave a residual to the farmer for his work and management.

Farm management studies in Alberta indicate that many farmers in every district attain these income requirements. Many do not, even with similar weather, soil and price conditions.

Land, labor, capital, and managerial ability are the resources of the farm operator. Wide differences between farms in the amounts and proportions of these resources cause profits to vary from farm to farm. Farm business analysis attempts to measure the efficiency with which each of these productive factors is being used, and to indicate methods of improving their overall effectiveness.

The Vital Factors

Farm management studies in Canada and other countries indicate that differences between incomes on farms in similar areas are associated with:

1. Size of business, or acres of crops and number of animals.
2. Use of labor, or output per man.
3. Use of capital, or turnover on investment.
4. Crop returns per acre.
5. Livestock returns per animal.
6. Enterprise combinations, or lines of production.

Local studies in Alberta show clearly that it is not always good land or large acreage that puts a farmer in the high income group. Some of the higher income farms on these studies were on only medium quality soils, while some smaller farms made higher incomes than some of the larger ones. Neither did those with the most livestock, or any certain type of livestock, always make the most money. Best results were obtained by that group of farmers who had favorable balances between, and who gave equal importance to all the six factors listed above. Farmers who were at least average or better in these factors made as much as $5,000 to $6,000 more per

year than those who were below average for the district in all six items. For each of the six factors in which a farmer was average or better, approximately $500 to $1,000 was added to his net income. Thus it is more important to bring all of these factors up to at least average for the district than to bring any one of them alone to a very high degree of efficiency. Once average levels have been attained in all, the next objective should be to raise all to above average levels.

These six major profit - promoting factors can be referred to as "THE BIX SIX" in Farm business management analysis. A farm business with widely differing levels of efficiency in the six items is described as "being out of balance." Equal degrees of efficiency place a farm "in balance" from the standpoint of good management.

The first concern in farm business analysis is to compare the operation to predetermined district standards in these factors.

MEASURING THE SIZE OF FARM AND LABOUR EFFICIENCY

The total acreage included in the farm is not a good measure of the size of the farm business. For example, an irrigated farm of 160 acres producing specialty crops would be a bigger business than a farm containing two or three sections of low grade grazing land. A better measure of the size of business would be the total investment in all farm assets including machinery and other equipment, livestock and all land owned and rented. The value of a year's production is also a good measure of the size of business, but these two factors should be taken into consideration together with the amount of labour that is used when measuring size of farm. Many studies of this factor suggest that the best size of farm in any locality or type of farm business is one a little larger than the existing average for the situation.

Measuring Overall Capital Efficiency

Rising wages and shortage of a farm labor has forced expensive farm mechanization. This has solved some farm problems, but has created others. On many farms the investment in machinery and buildings now exceeds that of land. While it has increased the output per worker, mechanization has introduced a new rigidity in the farm costs by altering and increasing the number and size of the expenses. It is therefore important not to exceed safe economic limits in substituting capital for labour. Every business including farming has a necessary rate of turnover on capital. Farmers whose gross yearly farm receipts would equal the total farm investment in three to four years are average in capital efficiency. Some do this in as little as two years while others take eight or more years. Such low rate of turnover could be due partly to over investment for the size of farm business, or to inadequate returns per animal, or acre.

Measuring Crop Efficiency

Most operators are conscious of the loss that can result from low crop yields. It is not so easy to assess in dollars and cents how the total crop enterprise compares to the district average, because, of different proportions of wheat, oats, barley and other crops in the program. The "crop index" method assesses the success of the cropping program.

Crop index is a percentage comparison of crop yields to the district average. It considers the weighted effect to all the crops, and not just the best field which had the most fertilizer, or other favorable treatment. On most farms it can be measured by calculating a weighted average of all physical crop yields. In cases where certain crops grown are more valuable per acre than others (e.g. flax, sugar beets, corn), it is better to use a monetary comparison, because low yields of a high value crop is more serious than in a lower valued one, e.g. cereal. This applies mainly to irrigated areas where specialty crops are grown. Under this system "crop index" is the value of the total crop as compared to its value if district average yields have been obtained. It is expressed as a percentage of the average. The following form will serve as a guide for the farmer wishing to rate his crops on a "crop index" basis.

Measuring Livestock Efficiency

In general, livestock efficiency amounts to the yield of saleable product per unit of each kind of livestock that is kept. In dairy production records should be kept of milk production per cow. In hog production the number of hogs per litter raised to market weight is the index of the efficiency of the enterprise. In beef production it is now recognized that individual animals and strains vary greatly in their ability to gain in weight and the efficiency with which they utilize feed, and the keeping of records of these factors also help the livestock man to cull out his poor performers and concentrate on the production of the superior types.

Selection of Enterprise Combinations

There is no simple measure of effect of enterprise combinations on farm earnings which would be suitable for any one farm.

Crops Grown	Acres	Total Yield	Yield Per Acre (a)	Total Value of Crop	District Yield Per Acre (b)
TOTALS			XXXX	XXXX	(a) XXXX

YOUR CROP INDEX will be (a) divided by (b) times 100%, or .....% of district average, where the average crop index for the district is rated at 100%.

Important items to consider in selecting a combination of enterprises on any farm are:

1. Relative profitability of different enterprises;
2. soil type and the amounts of tillable and untillable land;
3. the effect on labour distribution throughout the year;
4. farm size and location in relation to special markets;
5. to a certain extent the preferences of the operator.

Farm business studies show that enterprise combinations limit possible farm income when:

1. an enterprise contributes less than 20% to cash income;
2. when there are more than two livestock enterprises in addition to the usual crop enterprise;
3. when the enterprises compete seriously for the farmers' management and labour at peak seasons;
4. when a more profitable enterprise or combination of enterprises suitable for the district and soil type is being ignored.

Too many enterprises usually means that management will be spread too thinly to be effective. Also, a large number of enterprises on a typical size of farm means that one or more of them will be too small to mechanize adequately. A small enterprise may contribute very little to receipts in relation to the extra expense and labor involved.

BUDGETING

Budgeting is simply the planning stage of farming. The farmer who is alert will spend considerable time making and revising plans and examining various crop and livestock systems and practices. From these he will select the ones which promise the best income from the business as a whole over a period of years. Many operators make no formal or written plans, but estimate in a rough way and count on working out the details as they occur. The man with considerable experience and skill can plan or budget in this manner, especially for a simple business. The young farmer with limited experience needs a more definite plan. Any farmer could well afford to do some formal figuring under present changing conditions.

The important objective of budgeting is to compare alternative plans for prospective profit. The goal is not merely one of setting down a single plan to be followed without deviation. The real purpose is to figure out which of several business alternatives promise the best profit. It may be necessary to work out alternative budgets to see which will use the farm families resources to best advantage. Once a decision has been made the written budget can be very useful in checking actual progress against that anticipated.

Two General Types

Two types of budgets are commonly used: (a) complete budget (b) partial budget. The complete budget is used for estimating total returns and total costs for the whole farm business. The partial budget is useful for planning small changes within the business, e.g. adding a livestock enterprise, or purchasing equipment. The partial budget is an attempt to measure the costs and returns from a change of part of the farm business. Whatever the type of budget the goal is to make better use of resources.

Estimated change in Annual Net Farm Income from the proposed change of .....

.....

Additional Annual Costs Expected

1. Fixed Costs

Depreciation ..... $.....

Interest .....

Insurance .....

Taxes .....

Others .....

2. Operating Costs

Labor .....

Repairs .....

Feed .....

Fuel .....

Electricity .....

Other .....

Reduced Annual Receipts Expected .....

Sub-Total (A) ..... $.....

Additional Annual Receipts Expected ..... $.....

Reduced Annual Costs Expected

1. Fixed Costs .....

2. Operating Costs .....

Sub-Total (B) ..... $.....

Estimated change in Annual Net Farm Income (B-A) ..... $.....

OTHER CONSIDERATION

Extra Capital Needed ..... Degree of Risk .....

Extra Labor to Hire ..... Time lag till income starts .....

Other Advantages of Proposed Change	Other Disadvantages of Proposed Change
1.	1. .....
2.	2. .....
3.	3. .....

THE FARM BUDGET

Estimated Expenses

I. Operating Expenses	Expended Past Yr. $	Estimated Next Yr. $
Crops		
Livestock		
Livestock		
Poultry		
Gas, Oil, Grease		
Machinery Maintenance and Repair		
Building Maintenance and Repair		
Farm Truck		
Hired Labour and Custom Work		
General		
Miscellaneous		
Automobile (Farm share)		
Operating Expense Totals		
II. Capital Expenses		
Land		
Buildings		
Machinery and Equipment		
Capital Expense Totals		
Total estimated Expenditures		

Estimated Receipts

III. Cash Receipts	Received Past Yr. $	Estimated Next Yr. $
Crop Sales (state kind)		
Livestock Sales		
Livestock Products		
Miscellaneous Receipts		
Total Cash Receipts		
IV. Capital Sales		
Land		
Buildings		
Machinery, etc.		
Total Capital Sales		
TOTAL SALES		

MARKETING

Marketing considerations are of primary importance in most of the economic decisions made by farmers. A farmer may use the best technical know-how, manage effectively, and produce efficiently, yet lose out in the market place because he did not keep well informed on market conditions or use his knowledge effectively. While marketing usually is thought of as selling farm products, it also relates to purchasing farm supplies.

This section concerns the four major questions farmers must decide about buying and selling: what, when, where, and how.

What to Buy and Sell. This question is often thought of as a subsidiary to the larger question of what to produce. Actually, the questions are dependent on each other, so the basic production decision depends on market conditions in both purchasing and selling. This is most obvious in such a decision as cattle feeding where the feeder must consider at the same time the markets for feeder cattle and feed and the probable future market for slaughter cattle. The same considerations are involved in all production decisions where the producer has to make a choice among alternatives. For example, a choice between two crops may be influenced as much by the cost of fertilizer or a new piece of machinery as by the expected relative prices of the products. The same considerations are involved in deciding how much to produce. Similarly, the choice between selling feed directly or through livestock depends on the relative markets for the products.

When to Buy and Sell. Proper timing of purchases may well mean the difference between profit and loss. The prices of such things as feeder cattle, feed, and fertilizer tend to be low during some seasons of the year and high in others. While it may not be convenient to buy feeder cattle at the lowest point in the year, a study of price patterns over a period of time may indicate that a change in the time of purchase would be advantageous. Fertilizer dealers may be willing to sell or contract for spring delivery during fall or winter at a lower price than they would sell in the spring. Similarly, feed prices usually are lower at harvest time and increase through the year as storage costs are added to the price. However, it often is an advantage to buy at harvest time even if it is necessary to pay someone else for storage until the feed is needed.

Periodic price movements are especially important in livestock. Several types of these changes can be distinguished. Trends are general upward or downward movements over a long period of years and they usually pose no particular problems in timing of sales. Another type of price movement is the cycle. Livestock prices move up and down inversely to the production cycle. For beef cattle, these cycles are about eight to ten years in length while for hogs they are only about four years in length. It is not easy to predict when the turning point of the cycle will come and frequently farmers are caught by surprise and lose heavily on their operations as a result of an unforeseen reversal of the cycle. These cycles usually are caused by the concerted action of farmers to increase production when prices are high and to decrease production when prices are low. The result is that they usually are building up their herds at high prices and liquidating them at low prices. There is considerable advantage in doing exactly opposite to what the majority of producers are doing. It would even be better to maintain a constant rate of production than to change as most producers do.

A third type of price movement is the seasonal variation. Slaughter steer prices usually are highest about August and lowest about February, while fed calves usually peak in September and bottom in July. Hog prices on the average are at a maximum in August and a minimum in November. Sheep prices tend to be highest in July and lowest in October. These relationships may differ somewhat between markets and grades and in any given year the influence of the cycle or other variations may outweight the seasonal factor. A fourth type of price movement is called the irregular variation. This type of change may be due to such diverse things as international disturbances, tariffs, droughts, pestilences, feed prices, and supplies of competing products. Most of these things are difficult to predict so the irregular variation is itself largely unpredictable. However, it must be taken into consideration in planning at least to the extent of realizing that it exists.

Where to Buy and Sell. The individual choice of a dealer is a matter of personal choice. Some farmers place a high value in trading with a particular kind of dealer — a co-operative, a home-town business, a personal friend, etc. Other farmers prefer to compare qualities, services, and prices and choose on the basis of the greatest economic advantage. There is something to be said for both approaches and for avoiding the extremes of either. On the one hand, it does not make much sense to persist in patronizing a very inefficient dealer. On the other hand, buying from a dealer who charges very low prices may be a temporary advantage if his purpose is simply to drive out competitors so he can charge high prices later. In buying especially, it is necessary to compare quality and services before looking at price, while in selling it is desirable to compare grading, measuring, and payment practices before looking at price.

It is often particularly difficult to assess the relative merits of trading with co-operatives and other kinds of businesses. A well-run, efficient, farmer-owned co-operative should set a standard of performance by which other businesses may be judged. It offers the farmer an element of increased bargaining power and competition without which he might be much worse off. However, in individual cases, a co-operative may be less efficient than a competing business, so it provides no yardstick and offers no real advantage. It also is difficult to compare prices when the co-operative follows the practice of paying market prices set by other businesses and refunds whatever it has left over at the end of the year. Further difficulty is involved if the co-operative retains such amounts for a long or indefinite period. The producer who wishes to compare net prices must rely on past practices of the co-operative as a guide to the future.

Another type of comparison a farmer may make is between dealers at different locations or stages in the market process. For example, a cattle producer may sell to a local buyer directly, through a nearby auction, to a nearby abattoir, or on consignment in a terminal market. Here, he may be concerned further with the choice of a commission agency. It is very difficult to determine the relative advantages in such a case except by experience, either one's own or a comparison of neighboring producers.

How to Buy and Sell. Compared with the businessman, the farmer's decision of how to buy and sell is relatively simple. In other words, how he sells is largely determined by the dealers who buy from him and how he buys by those who sell to him. There are some cases such as selling certified seed, breeding stock, feeder cattle, and specialty crops direct to consumers, in which a farmer may use strategy in selling. That is, he may brand his products, advertise, arrange special sales, or render special services which will give him a competitive advantage. However, for the great majority of things the farmer sells and almost everything he buys, these considerations are irrelevant.

How to buy and sell in most cases is simply the combination of what, when, and where to buy and sell. The one factor the farmer can control to a large extent is the amount of market information he obtains and how he uses it. A poorly informed producer is at the mercy of the dealer and various impersonal market forces. By exploiting the various sources of information available to him, the producer can greatly improve his decision making. The sources include his district agriculturist, co-operative manager, field men, and various dealers with whom he trades. Published information is available from the Canada Department of Agriculture, Dominion Bureau of Statistics, Alberta Department of Agriculture, the University of Alberta, and various farm magazines, trade organs, and newspapers. Market news may be received by radio and special publications of various agencies.

A special kind of information which is invaluable in planning production and marketing operations is **outlook** material. Both short range and long range outlook information reports are available from the Federal and Provincial Departments of Agriculture. The Farm Economics Branch is initiating an outlook series which is available by request to the Branch or through district agriculturists.

CREDIT AND BUSINESS ARRANGEMENTS

How To Use Credit in Agriculture

Credit is a method used for getting control of an asset through the use of someone else's money. There is a right and a wrong way to use credit. Whether it is right or wrong depends on you, your financial position, the purpose to which you put it, etc. Credit can be used for consumption and for production articles. If you use it for consumption, you must pay it back from future income. Consumption credit (Credit used for immediate satisfaction and not to return a profit) should be used for savings and reasons of financial security.

If you borrow money for production, use it wisely. Don't borrow it at 5% and use it where it will return only 4%. When you borrow money be sure that it's the best solution to your problem and use it in the proper place on your farm. Credit is quite often more easily obtained than it is paid back. Records and budgets are an important tool of business. Why don't you rely on them too? It's a positive way — not hit and miss!

A. Where to Borrow

Now that you have decided credit is the best solution to your particular problem you need to know the sources of credit. These are outlined in Table I.

B. How Much Does Credit Cost

Credit is often misused because people do not know what they are paying — especially in consumer credit. Interest is the cost of using someone else's money. The true rate of interest varies a great deal and the actual simple annual interest rate may be something quite different from what you are sometimes told.

Suppose you borrow $1,000 for two years and pay it back at $50/month for 24 months:

You get		$1,000
You pay back	24 x 50 =	$1,200
Your loan cost		$ 200

Is this $\frac{200}{1{,}000} \times 100 = 20\%$ over two years?

$= 10\%$ per annum?

Or is it something else?

Remember you haven't had the use of $1,000 for the full two years. You have been paying some back each month. What then is the actual annual interest rate?

Use this formula and know for sure!

$$\frac{\text{(No. of pymts.) (amt. pd. back—amt. rec'd) (100)}}{\text{(No. of yrs.) (No. of pymts.} + 1\text{) (½ orig. loan)}}$$

The true interest rate in the above case is therefore:

$$\frac{24 \times (24 \times 50 - 1{,}000) \times 100}{2 \times (24 + 1) \times 500} =$$

$$\frac{24 \times 200 \times 100}{2 \times 25 \times 500} = \frac{96}{5} = 19.2\% \text{ per annum}$$

FARM RENTAL ARRANGEMENTS AND CONTRACTS

Farm Rental Arrangements

The most common basis for the rental of crop land in the Prairie Provinces is the conventional division of the crop between landlord and tenant. Out of his one-third share, the landlord pays taxes and other expenses for upkeep of his real estate, together with costs of maintenance of his property and his interest. The tenant pays all the other expenses of crop production, including labor and equipment, out of his two-thirds share of the crop.

Lease Principle and Calculation

Leasing arrangements for land represent a pooling of resources by the landlord and the tenant. In general, an equitable distribution of the proceeds of gross farm income would return a share to the landlord and the tenant that is in proportion to their contributions to the expenses of the production of the crops. The conventional one-third, two-third, leasing arrangement would thus reflect a situation where the landlord's contribution was equal to about one-half that of the tenant.

While the principle of sharing returns in the same proportion as costs are contributed is easy to recognize, there are certain difficulties in measuring these contributions when they take the form of land on the one hand, and labor and cash on the other. The first requirement in comparing the contributions of the landlord and the tenant is that both must be reduced to an annual basis. These contributions may then be set out and used as a basis for dividing gross receipts.

The land may be given an annual value by allowing for a return of interest on the investment, based on current rates and a fair valuation of land and buildings. The price for comparable land in the district provides the best evaluation, and the rate of interest should be equal to that received from land mortgages.

The tenant under this one-third, two-thirds, rental arrangement, provides the labor, machinery and cash operating expenses. These factors must be given an annual valuation which may be compared with the allowance for interest made to the landlord. The value of labor may be judged from the current rate of farm wages. The necessary cash expenses are a matter of record-keeping. The valuation of the machinery is more difficult, since both interest on investment and depreciation must be considered. Values of farm machinery may be set in relation to local prices at auction sales and from dealers. An allowance for interest is first credited to the tenant on account of his machinery. Allowance for depreciation, are not easily determined and no fully satisfactory standards are available. These rates should have a close relation to the lifetime of the machines and are often set too high by underestimating this lifetime. For ordinary equipment on Prairie farms, the following may serve as a guide; special equipment (truck, tractor and combine), 15 percent; all other machinery, 10 percent.

When the landlord's and the tenant's respective contributions have been determined in this way, they can be set down in a simple account as in Table I, to show the proportion in which these costs are shared by each and to serve as a guide for the sharing of gross income.

In practice, the division of costs will not be exactly in the one-third, two-thirds, ratio mentioned. A tenant may have more equipment than is necessary. Giving him a full allowance for this equipment in calculating his contribution and claim on the proceeds, would result in an unfairly reduced share for the landlord.

PROFIT SHARING CONTRACTS

The principles underlying any contracts in which profits are to be shared are no different than the principles of a fair rental arrangement for an entire farm. In taking cattle on share, for example, each party should be rewarded in the same proportion as they have contributed. The owner of the cattle usually contributes the fixed cost of interest on his cattle investment, replacement of old cows (depreciation), risk of death loss, etc. The person taking the cattle on share has to provide feed and shelter and the labor to look after them. There are also veterinary bills, minerals, etc., to be bought. All these must be agreed

upon and a fair value assigned to each contribution. The gross income from the cows (i.e., calves) can then be divided in proportion to the costs. This can often be better than simply relying on tradition because tradition does not change as rapidly as costs and technology do. A clearer understanding of the costs involved as well as their division can be a key to a better relationship between both parties.

Often the cattle owner feels the tenant is not taking proper care of the cattle and the tenant feels that the cattle owner is skimming off all the profit and not leaving him anything. It may be that both are right and it may also be that if there were a clearer understanding of what is going on that there would be increased profits from the enterprise and more money as the end result to both parties.

Some basic points to remember are:

1. That in addition to the practical aspects of contracts (they need to be economically sound to satisfy those involved) the legal implications must not be overlooked. A lawyer can put the thoughts of both parties down so that the contract is binding in the event of possible disagreements or misunderstandings later on.

2. That better tenants can be obtained if:

(a) Security is offered through a longer term lease or contract. A tenant can only be expected to invest in items from which he can get his money back.

(b) Adequate buildings and improvements are provided in a rental deal.

(c) The productive capacity of the land (or livestock in a livestock sharing arrangement) is high and gives both the tenant and landlord equitable returns based upon the proportions of their contributions.

3. That landlords are more apt to be satisfied if:

(a) The tenant takes initiative in conducting the production and marketing operations effectively.

(b) The tenant does not mine the farm resources.

(c) The tenant is receptive to general observations from the landlord.

FARM BUSINESS ARRANGEMENTS

In this age the farm is facing a technological revolution. The number of farms is declining, young people especially are leaving agriculture. To some extent this is something that we must accept. As the productivity of those engaged in farming increases those least able to compete will look for places where they will be able to. Those that remain must constantly adjust their operations towards greater economic efficiency.

As people leave the farm there arises the problem of how to make a smooth transfer to the new owner, usually the new generation. This transfer most often takes place within the family itself. Dad retires and one of the sons takes over the place. This transfer is not something that can be done suddenly. Groundwork should be done early or various disappointments are bound to result. The son should realize that the farm represents a lifetime of work on the part of his parents and that provisions for their future economic well-being must be made.

In preparing for the final transfer of the farm there will quite often be an interval in which both the father and son are actively engaged in the farm operations and are both dependent upon it for their income. This should not present any problems if a proper farm business operating arrangement is adopted.

There are several arrangements which can be chosen depending upon the stage of preparation and the particular circumstances involved.

1. No formal agreement or perhaps only a verbal one — no one knows where he stands and only misunderstanding and trouble can result.

2. Wage agreement — for a temporary period the son may receive wages for his efforts. This should be supplemented at an early date by a more permanent arrangement that will add incentive to the son's interest on the farm.

3. Enterprise agreement — the son has the major responsibility of one or more enterprises on the basis of self sustainence for each such enterprise. This enterprise(s) should not be the only responsibility since he should learn the entire farm business.

4. Rental arrangements on a share or cash basis — generally a share basis is necessary because of the risk factor involved. This will give the son some responsibility in the farm operation.

5. Father - Son Partnership Arrangement — this should be written and should state the purpose of the agreement, the duration of the contract, the contributions to be made by each party, who should keep the records and how, division of income, methods of settling arguments and the limitations on partners actions as well as provisions for final transfer. A partnership is not too expensive to establish, there is not too much "red tape" involved and can easily be dissolved.

On the other hand in a partnership each partner is liable for for the debts of the others, the transfer of assets is not clear cut and the partnership ceases on the death or withdrawal of one partner (regardless of how many there are).

Father - Son Partnership Agreements do offer a workable arrangement and if fairly laid out and properly executed will fit well into the transferal scheme of the farm assets. Again as in the case of leases and contracts, legal opinion and help can be a big aid to avoid various pitfalls as time goes on.

6. Incorporation—Farms in Alberta may incorporate under the Companies Act. Generally a farmer does not incorporate unless he has $75,000. - $100,000. invested and has a taxable income in excess of $10,000. As distinguished from a partnership a corporation has perpetual existence, shares are easily transferred and the shareholders are not liable for the debts of the company. There are possible tax advantages on high income farms.

However corporations are more costly to establish, there are annual reports and audits to file and they are more difficult and costly to dissolve. There may even be tax disadvantages on small farms.

Careful and detailed study should be given to these methods before any one of them is adopted. All angles of both the economic and legal implications should be investigated before a decision is made.

The farm transfer process is made more or less gradual through the use of these methods. The final transfer will have to be made in one of the following ways:

(a) by will
(b) agreement of sale
(c) by gift
(d) by cash and mortgage
(e) rental with purchase option.

Having decided upon who is to get the farm there are several important considerations to bear in mind. There should be provision for adequate income for the parents, for the son getting the farm, provision for compensation to children not getting the farm, and consideration for Federal and Provincial Income and Estate tax laws. The mutual consideration and approval of the plan by all parties involved should be obtained. It is important as well to consult a solicitor to assure legality of the plan.

In all cases it is important that a farm unit be of economical size or all the provisions contained in operating agreements and transfer arrangements will fall short of their intended purpose.

TABLE ON SOURCES OF FARM CREDIT

Source	Money can be used for	Interest Rate	Regulations and Stipulations
1) **Farm Improvement Loans** Handled by chartered banks under a system of federal government backing.	Purchase of farm implements, breeding stock and in the case of land owners to build or alter farm buildings, fences, electrical heating, plumbing, drainage systems, but not for the purchase of land.	5%	Principle occupation must be farming. The maximum loan available to a farmer at any one time is $7,500. Loans can be made to cover from 60% of the cost of the items in the case of second hand equipment, up to 90% on some of the loans made for real estate, construction or improvement. Length of repayment depends on the size of loan, but in the case of farm implements the maximum length of time is three years. Maximum on some of the other loans is 10 years. Security in most cases is taken on the purchased item only.
2) **Farm Credit Corporation** Crown Corporation of the Dominion Government reporting to the Minister of Agriculture. Funds are borrowed from the Dominion Government by the Corporation and loaned to farmers. Alberta Branch office is located in Edmonton with 31 Field Offices in major centres throughout the province.	To be used primarily to meet long-term credit needs, for reorganization of farms involving the purchase of land, improvements to land and buildings; purchase of basic herd livestock and essential farm equipment; discharge of liabilities or any purpose which the Corporation may consider necessary for the assembly and operation of an economic family farm unit.	5% with 5½% on arrears; amortized payments up to 30 years.	Principle occupation must be farming. The applicant must provide a suitable plan for the assembly of a farm unit capable of producing sufficient income to meet all operating costs, and provide an adequate standard of living and orderly repayment of the required credit. The security taken is a first mortgage on the land owned or to be purchased with loan assistance and operated by the applicant. Part II Loans: are secured on real estate only; the maximum loan is the lesser of $20,000 or 75% of the Agricultural Productive Value. Part III Loans: can be made to individual farmers between the ages of 21 and 45 with 5 years farming experience. This loan can be secured by first mortgage on real estate, livestock, and equipment with the maximum loan being $27,500 or 75% of the acceptable security. Group life insurance is available to all borrowers and is compulsory for all Part III borrowers. The applicant is required to pay an application fee and all legal costs involved in the processing of the loan.

TABLE ON SOURCES OF FARM CREDIT

Source	Money can be used for	Interest Rate	Regulations and Stipulations
3) **Veteran's Land Act** Administered and advanced by the VLA Department of the Federal Government to veterans only.	To purchase land, buildings, permanent improvements, livestock and farm equipment.	3½% on initial loan, plus 5% on supplementary loans.	Borrower must satisfy minimum service requirements, and pass a screen board as to suitability as a farmer. Under Part I of the Act, $6,000 is maximum loan for 25 years, and usually pay interest **only** at 3½% in first year of contract with total repayment spread over 24 years on an annual amortized basis. Ten percent down payment is required. In addition, $20,000 at 5% amortized over 30 years, is available under Part III. The total Part III loan obtainable is $20,000 less (a) present cost to the Director of existing Part I loan, plus (b) full amount of any previous Part III loan. (i.e. Part I, Land & Permanent Improvements $4,800 plus Livestock & Equipment $1,200 = $6,000 — 10% of $4,800 = $480, which leaves a cost to the Director of $5,520. Then the maximum Part III loan available would be $20,000 — $5,520 = $14,480.) VLA holds title to the property, and loan repaid under supervision of VLA fieldman.
4) **Credit Unions** Set up by interested members and incorporated as a credit union under the co-operative Activities Branch, Department of Industries and Labor, Alberta Government. Money available for lending comes entirely from Depositor members.	Anything the borrower wishes including personal as well as business items.	1% per month on the unpaid balance for small loans, and ½% per month on loans over $200 usually.	The maximum available to a borrower depends strictly on the reserves of the credit union and the security offered and ability of the borrower to repay. These stipulations are set up by the Credit Union's own board of directors. Usually the loan can be considered short term to intermediate credit with a maximum borrowable of several thousand dollars over several years, the amount and length of time depending on Credit Union assets and security of borrower. Security taken will depend on the particular Credit Union policy, but may include real estate, securities or chattels.

TABLE ON SOURCES OF FARM CREDIT

Source	Money can be used for	Interest Rate	Regulations and Stipulations
5) **Farm Purchase Credit Act** — Loans are processed through a Farm Purchase Board which is set up by municipal by-law and agreement with the Government of Alberta.	For the purchase of land to assist farmers in establishing economic farm units, and at the same time to provide a substantial down payment to the person who is selling the farm.	5%	The purchase upon approval by the Board, makes a down payment of 20% on the land. The Government pays approximately 50% or a maximum of $10,000 which gives the seller about 70% of the selling price. The balance owing to the vendor is guaranteed by the Government and the vendor is paid out first. The debt can be paid over a period of up to 20 years, provided payments do not go beyond the borrower's 66th birthday. Loans will be made only on a farm which is self-supporting, or for which an addition is required to make it so. Assistance can be granted only if the proposed purchase and present holdings do not exceed a value of $30,000.00.
6) **Ordinary Bank Loans**	Usually for operating capital and other transactions of a short term nature. Banks do not make loans for land purchases in the sense of mortgages, but may make short term loans of less than 1 and up to several years duration for that or any other purpose.	Presently about 6% on farm loans.	Security may be bonds, other securities, real estate, but not usually chattels. Payments can be arranged to suit the farmer's production cycle but most bank loans to farmers can be considered short term of possibly a year's duration.
7) **Insurance, Trust and Mortgage Companies**	Usually purchase of real estate.	Usually fairly competitive with banks.	Mortgage, insurance and trust companies have largely withdrawn from loaning money on land after their loss experience during the depression of the thirties. In some cases, they may loan on superior quality land, but this money source can be considered strictly limited to farmers.

TABLE ON SOURCES OF FARM CREDIT

Source	Money can be used for	Interest Rate	Regulations and Stipulations
8) **Merchant, dealer, and finance companies.**	Supplies, equipment bought both for business and personal.	Usually range from 10% to 25% averaging around 20%.	Credit through these sources is usually easily obtained directly or indirectly through dealers wishing to sell their product, or through loan companies set up strictly to make money loans. In return for the high interest rates, the loan is usually easily obtained, without embarrassment and often with little or no definite tangible security required.
9) **Agricultural Processors and Feed Companies.**	To be used in one or more of the steps in the production of some farm commodity.	Usually competitive with interest rate.	Usually there is a contract of some type integrating the farmer and processor. Each is required to live up to a certain set of rules established in the contract. The contracted product usually goes to the contracting processor, or in the case of a feed company, the farmer must use its feed.
10) **Feeder Associations** Are set up under the Co-operative Association Act, but operate under the Feeder Associations Guarantee Act which is administered by the Livestock Branch, Alberta Dept. of Agriculture. Money is acquired by the association wherever it can obtain the best interest rate.	The purchase of feeder cattle and lambs.	Presently about 5%.	An association can borrow a maximum of $200,000 with upper limits set on the maximum amount which any individual may borrow, usually about $5,500. No breeding stock may be purchased under this loan. The provincial government guarantees loaning institutions against losses up to 25% of the total loans out for that feeder association. Feeder associations operate most successfully in a predominently livestock feeding district and thus tend to be limited to farming areas where livestock feeding is a major and permanent enterprise.

Other smaller sources of credit under provincial legislation are the Homestead Lease Loans Act allowing up to $1,000 for land clearing, and Rural Electrification Revolving Fund Act. Loans available for farm home improvement are presently under consideration.

Agricultural Services

Alberta Department of Agriculture

Administration—The Deputy Minister is responsible for general direction and administration of policy, personnel, accounting, etc.

Executive Assistant to Deputy Minister —administers The Land and Forest Utilization Act, The Agricultural Rehabilitation and Development Act (ARDA), The Farm Purchase Credit Act, and generally assists the Deputy.

Extension Branch—This Branch assumes the major responsibility for the Province of providing agricultural and home-making information and guidance to farm families through meetings, short course schools, field days, demonstrations, publications, radio, television, personal farm or office calls and correspondence.

The Branch is responsible for overall administration and direction, of all 4-H Clubs in the Province. Extension offices throughout the Province staffed by District Agriculturists and District Home Economists work directly with farm families and farm organizations in all phases of farm and home management and husbandry practices. Supervisors provide detailed administration and supervision of District Agriculturists and District Home Economists.

Subject matter specialists within the department, at Research Centres and at the University, provide more specialized help when required.

Main divisions under this Branch are: District Agriculturist Division, District Home Economist Division, 4-H Division, and Agricultural Engineering Division, The Branch administers the Agricultural Societies Act, the Names of Homes Act and Farm Labour Program. All Departmental publications are printed and distributed by this Branch, as well as the distribution of a large number of agricultural and home-making publications from the Universities, Research Institutions, and other sources.

Field Crops Branch—responsible for providing services to those engaged in crop production, horticulture and apiculture. For administrative purposes there are five principal divisions within the Branch, namely, Crop Production and Improvement; Soil Conservation and Weed Control; Crop Protection and Pest Control; Horticulture and Apiculture. Each is administered by a Supervisor, who is responsible to the Commissioner. In addition the Branch is charged with the operation of the Horticultural Station at Brooks and the Tree Nursery at Oliver.

The Branch, through the Supervisors and Fieldmen, administers legislation relative to the various phases of crop production, develops and implements policies to guide the courses of production and endeavors to keep informed on research and experimentation as applied to production. The Supervisors are specialists in a particular phase of Agriculture. They serve farmers through local Agricultural Boards and the District Agriculturists.

Livestock Branch—Administers Acts and policies under which the following activities are governed: brand inspection and registration, licensing of butchers and hide dealers, licensing and bonding of livestock dealers and agents, licensing of auction markets and stockyards, pounds or herd law in Local Improvement Districts, pure bred sire areas, Alberta livestock exhibit to the Royal Winter Fair, the Horned Cattle Purchases Act, the Cattle Improvement (bull) policy, the Swine Improvement (boar) Policy, the Sheep Impovement (ram) Policy, the 4-H Dairy Heifer Calf Policy, the artificial insemination policy, the livestock feeder's associations, specialized livestock extension, general livestock improvement promotion, investigation of stock losses and trade practices.

Dairy Branch — Administers legislation dealing with dairying, frozen food locker plants and margarine. The services available include: Dairy herd improvement programs, laboratory control service for dairy plants, mastitis control program for dairy herd owners, checking milk supplies for adulteration from antibiotics, pesticide residues and added water, inspection and instruction for dairy and frozen food locker plants and specialist assistance to extension workers.

Radio and Information Branch—Present daily the ten-minute radio program Call of the Land over a province-wide network, and maintains a flow of timely information in the weekly press releases Farm Notes and Science and the Land.

Poultry Branch — Administers Acts and policies with respect to: flock approval; turkey approval; licensing and bonding of hatchery operators, egg grading stations and poultry processing plants; Alberta Random Sample Test; the poultry associations (hatching egg shippers, turkey breeders, hatchery, and produce); specialized poultry extension; general poultry production improvement promotion; investiga-

tion of poultry losses and trade practices.

Schools of Agriculture—Under the Agricultural Schools Act several schools are established and directed by the Department offering vocational training in Agriculture for boys and in Home Economics for girls. Schools are located at Olds, Vermilion and Fairview.

Fur Farm Branch—Administers the Fur Farm Regulations and assists the fur farmers with information on ranch management, nutrition, genetics and disease.

Veterinary Services Branch—Administers regulations covering stockyard inspections, Brucellosis Restricted areas, livestock medicines, poultry vaccines, humane slaughter and other matters affecting livestock health in Alberta. It conducts an extensive laboratory diagnostic and limited research service, and advises on animal disease problems of Agriculture and other Departments of Government.

Farm Economics Branch—Data and information on cost and returns in production of specific farm products are collected, analyzed and distributed. An extension-education program is conducted with farmers and ranchers on the principles of farm management, marketing and agricultural development. In co-operation with the Dominion Bureau of Statistics the Branch collects, analyzes and disseminates statistics on production, prices and values of various commodities produced in Alberta.

DISTRICT AGRICULTURISTS

Office	Address	Office	Address
ATHABASCA	Box 480	LETHBRIDGE	Admin. Bldg.
BARRHEAD	Box 850	MAYERTHORPE	Box 146
BERWYN	Box 36	MEDICINE HAT	Medical Bldg.
BONNYVILLE	Box 160	OLDS	Box 250
BROOKS	Box 788	PONOKA	Box 70
CALGARY	702-16 Ave. N.W.	RED DEER	Provincial Bldg.
CAMROSE	Box 520	ROCKY Mt. HOUSE	Box 700
CARDSTON	Box 38	RYLEY	Box 200
CLARESHOLM	Box 40	SEDGEWICK	Box 9
CORONATION	Box 507	SMOKY LAKE	Box 70
DRUMHELLER	Box 578	SPIRIT RIVER	Box 189
EDMONTON	10426-81 Ave.	STETTLER	Box 1119
M.D. of Strathcona	(Strathcona County Office)	STONY PLAIN	Box 510
		STRATHMORE	Box 125
EDMONTON	10302-107 St.	ST. PAUL	Box 188
M.D. of Sturgeon			
GRANDE PRAIRIE	Provincial Bldg.	TABER	Box 640
HANNA	Box 349	TWO HILLS	Box 487
HIGH PRAIRIE	Box 568	VEGREVILLE	Box 519
HIGH RIVER	Box 490	VERMILION	Box 568
LAC LA BICHE	Box 389	VULCAN	Box 480
LACOMBE	Box 99	WAINWRIGHT	Box 459
LAMONT	Box 359	WESTLOCK	Box 429
LEDUC	Box 248	WETASKIWIN	Box 130

Canada Department of Agriculture

Assistance is available in the fields of research, production and marketing, and special assistance such as the Prairie Farm Rehabilitation Act and the Prairie Farm Assistance Act. A research station, an animal diseases research institute, four experimental farms and three experimental substations are operated by the Department. The soil survey is carried on co-operatively with the Provincial Government. Regulatory and promotional activities carried on by the Production and Marketing Branch involve the grading and inspection of agricultural products, animal disease control, regulation of trade in seeds, feeds and fertilizers, performance testing of livestock and poultry, and financial assistance toward the promotion of better agriculture. Water conservation and community pasture development are examples of conservation activities carried out under the Prairie Farm Rehabilitation Act. The Prairie Farm Assistance Act, and the Crop Insurance Act provide for measures of assistance to farmers in crop failure areas.

Regional headquarters for the various units are shown hereunder. The Health of Animals Division is concerned with meat

inspection at inspected slaughtering plants, and with the control and eradication of animal diseases. Fruit and Vegetable and Dairy Products Division officers are concerned with the inspection and grading of these products. The Livestock Division is responsible for the grading of livestock products and for the operation of policies designed to improve livestock quality. The Plant Products Division promotes the development and use of better seed, and regulates the trade in seeds, feeds and fertilizers. The Poultry Division is responsible for the grading and inspection of eggs and poultry, and for the administration of the national poultry policies. Under the Plant Protection Division is certified seed potato work and the administration of legislation designed to prevent the entry of foreign plant diseases and insect pests. The Economics Division, now associated with the Administration Branch of the Department, maintains a regional office in Edmonton. The Board of Grain Commissioners for Canada under authority of the Canada Grain Act controls and supervises grain handling in Canada.

The Canadian Wheat Board is the selling agency for all wheat, oats, and barley produced in Western Canada and sold interprovincially or abroad. The Farm Credit Corporation has the responsibility of administering long term mortgage credit designed to help Canadian farmers reorganize their industry into economic family farm units. The Canadian Wheat Board and the Farm Credit Corporation report to Parliament through the Minister of Agriculture.

RESEARCH BRANCH

Beaverlodge—Experimental Farm
Field and horticultural crops, livestock, apiculture, and soils.

Edmonton—Alberta Soil Survey, University of Alberta. Pedology and soil survey.

Fort Vermilion—Experimental Farm: Field crops and livestock.

Lacombe—Experimental Farm
Livestock and poultry breeding, field and horticultural crops. Cereal and forage crops diseases and their control, and soils.

Lethbridge—Research Station
Irrigated and dry land agriculture involving livestock, field and horticultural crops, livestock nutrition, wool research; insects and diseases affecting field and horticultural crops and their control; insects affecting livestock and their control.

Manyberries—Experimental Farm: Livestock breeding and range management.

Stavely—Range Experimental Substation: Range management.

Vauxhall—Irrigation Substation: Consumptive use of water and related soil problems.

Vegreville—Experimental Substation: Problems with solonetzic soils.

PRODUCTION AND MARKETING BRANCH

Brooks	
Fruit and Vegetable Division Office	Post Office Building (Box 370)
Calgary	
Dairy Products Division Office	530 Public Building
Fruit and Vegetable Division Office	Immigration Building
Health of Animals Division,	
District Veterinarian	403 Public Building
Sub-District Office	407 Public Building
Stockyards Office	302 Livestock Exchange Building
Livestock Division Office	409 Public Building
Stockyards Office	308 Livestock Exchange Building
Plant Products Division Sub-District Office	Immigration Building
Analytical Control Laboratory	102 - 11th Avenue E.
Poultry Division Office	2 Immigration Building
General Service Section	730 Public Building
Camrose	
Health of Animals Division Sub-District Office	Federal Building (Box 1150)
Consort	
Health of Animals Division Sub-District Office	Federal Building (Box 354)

Coutts		
	Health of Animals Division Sub-District Office and Quarantine Station	Customs and Immigration Building (Box 143)
Drumheller		
	Health of Animals Division Sub-District Office	Post Office Building (Box 230)
Edmonton		
	Dairy Products Division District Office	882 Federal Building
	Fruit and Vegetable Division Office	Federal Building
	Health of Animals Division Sub-District Office	761 Federal Building
	Livestock Division District Supervisor	878 Federal Building
	Stockyards Office	c/o Edmonton Stockyards
	Plant Products Division District Supervisor	870 Federal Building
	Plant Protection Division Office	820 Federal Building
	Plant Inspection and Seed Potato Certification	820 Federal Building
	Poultry Division Office	899 Federal Building
	General Service Section	878 Federal Building
Fort McLeod		
	Health of Animals Division Sub-District Office	Unit No. 1, Downtown Motel
Grande Prairie		
	Health of Animals Division Sub-District Office	Storcer Block, 9924 Richmond Avenue
	Plant Products Division Office	Post Office Building (Box 3117)
Lethbridge		
	Fruit and Vegetable Division Office	306 Public Building (Box 1084)
	Health of Animals Division Sub-District Office	401 Post Office Building
	Animal Diseases Research Institute (Western)	Post Office Box 639
	Livestock Division Office	c/o Alberta Stockyards
	Plant Products Division Office	Post Office Building
	Plant Protection Division Office	310 Post Office Bldg. (Box 745)
Medicine Hat		
	Health of Animals Division Sub-District Office	Federal Building
Olds		
	Health of Animals Division Sub-District Office	Popowich Building (Box 1329)
Peace River		
	Health of Animals Sub-District Office	Post Office Building (Box 1120)
Red Deer		
	Health of Animals Division Sub-District Office	108 Public Building
	Plant Products Division Office	212 Public Building
	Poultry Division Office	214 Public Building
Stettler		
	Health of Animals Division	Post Office Building (Box 1330)
Vermilion		
	Health of Animals Division Sub-District Office	Federal Building (Box 1017)
Wetaskiwin		
	Health of Animals Division Sub-District Office	Federal Building (Box 430)

SPECIAL ACT ADMINISTRATION

Prairie Farm Rehabilitation Administration — P.F.R.A.

District Offices — Public Building, Calgary, Alberta.
Federal Building, Lethbridge, Alberta.
Federal Building, Vauxhall, Alberta.

Regional Offices — Hanna, Medicine Hat, Fort Macleod, Peace River, Wainwright.

Prairie Farm Assistance Administration — P.F.A.A. — Federal Building, Edmonton.

Registration of Purebred Animals

Correspondence concerning the registration of purebred animals of all breeds, Holstein-Friesian excepted, should be sent to the Accountant, Canadian National Livestock Records, Department of Agriculture, Ottawa; for the registration of Holstein-Friesian cattle to the Secretary, Holstein-Friesian Association, Brantford, Ontario.

FARM CREDIT CORPORATION

Regional Office — 100 Street & 101A Avenue, Edmonton.

BOARD OF GRAIN COMMISSIONERS

Inspection — Calgary, 619 Public Building.
— Edmonton, 814 McLeod Building.
— Lethbridge, Canadian Government Elevator, Box 637.

Weighing — Calgary, 616 Public Building.
— Edmonton, Canadian Government Elevator, Box 3592, Postal Station D.
— Lethbridge, Canadian Government Elevator, Box 637.
— Medicine Hat, Ogilvie Flour Mill.

Canadian Government Elevators — Calgary, 637 Public Building.
— Edmonton, Canadian Government Elevator.
— Lethbridge, Canadian Government Elevator.

CANADA WHEAT BOARD

Branch Office for Alberta, 201 - 509 - 3rd Street, S.W., Calgary.

UNIVERSITY OF ALBERTA

Department of Agricultural Economics — — Information on the economics of agricultural adjustment, finance, management, marketing, policy, prices, production, and and rural development.

Department of Agricultural Engineering — Information on farm power and machinery, farm buildings and services, handling and storing agricultural materials.

Department of Animal Science — Information on the care, feeding, breeding, and management of farm livestock and poultry.

Department of Dairy Science — Information on production, handling and processing of milk; processing of milk products; principles of food processing; problems concerning agricultural microbiology.

Department of Entomology—Information on the identification and control of insects.

Department of Genetics — Information on cereal and forage varieties.

Department of Plant Science — Information on control of vegetation and of plant diseases, horticulture including vegetable varieties and gardening, fruit and flower growing, horticultural pests, landscaping, etc.

Department of Soil Science — Information on soil fertility; use of commercial fertilizers, barnyard manure, straw, stubble, etc.; use of mineral soil amendments (gypsum, lime, etc.); crop rotation; improvement and fertilization of soils for lawns and gardens; soil erosion; irrigation; soil salinity ("alkali"); inoculation of legumes; soil survey information, etc.

Agricultural Soil and Feed Testing Laboratory—This laboratory, on the Edmonton campus, is financed largely by the Alberta Department of Agriculture. Alberta farmers, home owners, and greenhouse operators may submit soil samples for testing; only unmixed samples of farm-grown feeds are accepted for analyses. Recommendations based on the tests performed are sent to those submitting samples.

Instructions and sample containers are available from the Laboratory or from District Agriculturists.

Department of Extension — Distribution of agricultural circulars and bulletins written by University staff members; up-to-date lists of agricultural pamphlets and bulletins available from major sources in Canada and the United States: advisory service on community leadership and community activities; provision of speakers upon request; film library with extensive coverage of both agricultural and other topics; Extension Library service through open shelf borrowing, travelling libraries; Extension Specialists in Music, Art and Drama for classes in rural points; arrangement of short courses, classes and conferences both on and off campus.

PRODUCTION COMMITTEES

AGRICULTURAL ENGINEERING

Reid, J. L. (Chairman)
Anderson, D. T.
Stephanson, B. T.

BEES

Edmunds, J. W. (Chairman)
Pankiw, P.

CLIMATE

English, R. E. (Chairman)
Carder, Dr. A. C.
Toogood, Dr. J. A.
Thompson, C. E.

FARM MANAGEMENT

Purnell, Dr. G. R. (Chairman)
Haase, G.
Manning, Dr. T. W.

FIELD CROPS

Cereals

Person, Dr. C. O. (Chairman)
Grant, Dr. M. N.
Guitard, Dr. A. A.
McFadden, A. D.

Plant Diseases and Pests

Evans, Dr. W. G. (Chairman)
Gurba, J. B.
Holmes, Dr. N. D.
Lebeau, Dr. J. B.
Skoropad, Dr. W. P.
Tyner, Dr. L. E.

Weed Control

Friesen, H. A. (Chairman)
Corns, Dr. W. G.
Lobay, W.

Forage Crops

Bratvold, O. G. (Chairman)
Baenziger, H.
Lesins, Dr. K. A.
Peake, R. W.

Cultural Practices and Crop Sequence

Bratvold, O. G.
Russell, Dr. G. C.
Stephanson, B. T.
Webster, Dr. G. R.
Lobay, W.
Walker, D. R.

HORTICULTURE

Andrew, Dr. W. T. (Chairman)
Des Champs, A.
McCalla, P. D.
Knowles, R. H.

IRRIGATION

McAndrews, C. J. (Chairman)
Graham, S. S.
Russell, Dr. G. C.

LIVESTOCK

General, Breeds and Breeding, Nutrition, Management

Mead, W. H. T. (Chairman)
McElroy, Dr. L. W.
Slen, Dr. S. B.

Dairying and Dairy Products

McCallum, D. H. (Chairman)
Clegg, Dr. L. F. L.
Dixon, R. P.

Poultry

McMillan, R. H. (Chairman)
Clandinin, Dr. D. R.
Downs, J. H.

Diseases and Pests

Ballantyne, Dr. E. E. (Chairman)
Haufe, Dr. W. O.
Lewis, Dr. A. E.

SOILS

Fertility and Zonation

Toogood, Dr. J. A. (Chairman)
Friesen, H. A.
Hennig, A. M. F.
Russell, Dr. G. C.
Webster, Dr. G. R.

Management

Russell, Dr. G. C. (Chairman)
Bratvold, O. G.
Dew, D. A.
Goettel, A.

Named above are committee members only. Many other specialists of the University of Alberta and the Canada and Alberta Departments of Agriculture assisted with preparation of the Farm Guide. Their help and advice are gratefully acknowledged.

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